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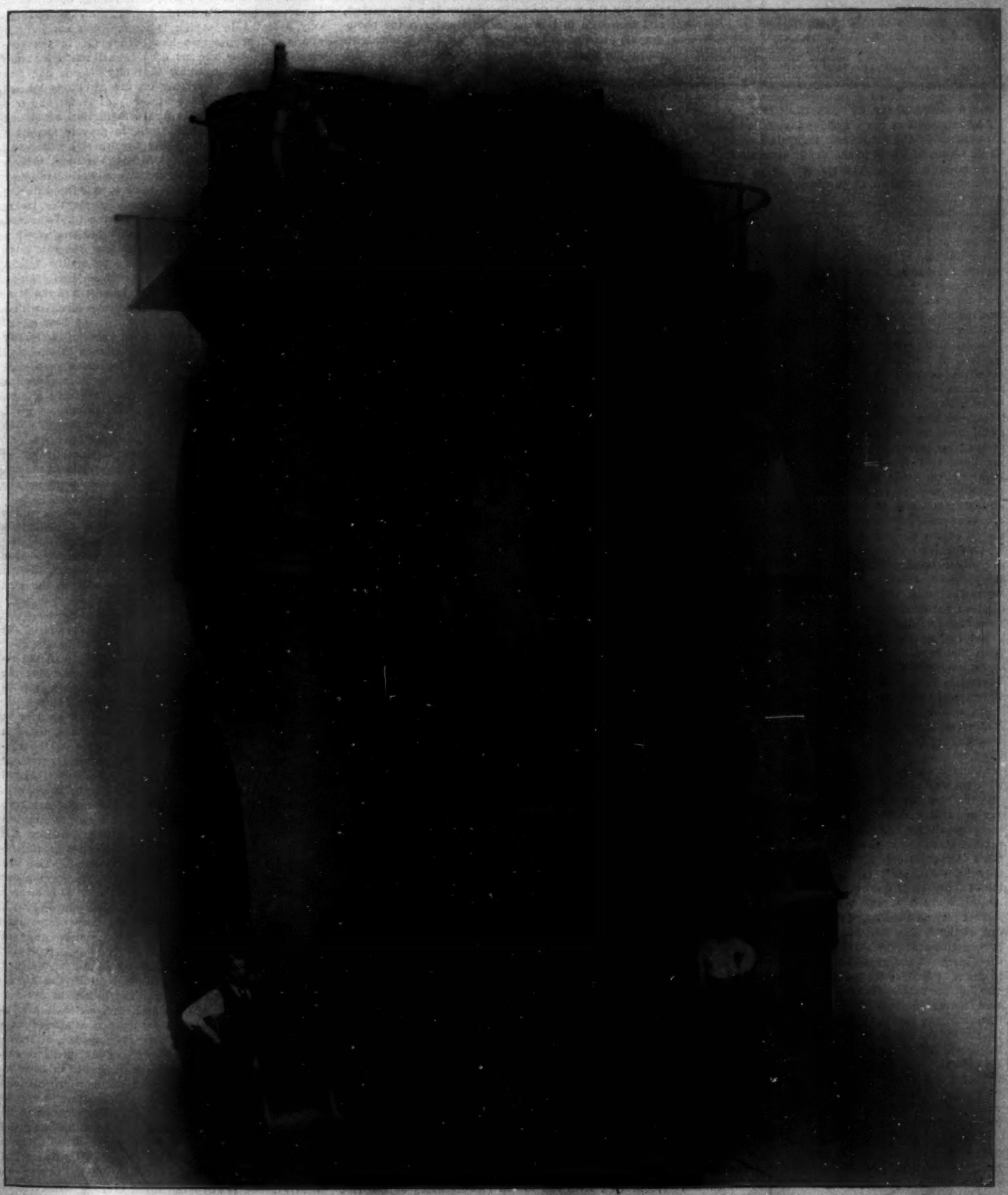

Weight, 264,000 pounds. Height, 20 feet. Weight of Wheel, 5 tons. Weight of 22-inch Shaft, 10 tons. Intake, 10 feet diameter. Amount of water passing through per minute, 400,000 gallons. Built for the Shawinigan Power Station, Canada.

THE LARGEST WATER TURBINE IN EXISTENCE. -[See page 6.]

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SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, JANUARY 7, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RETROSPECT OF THE YEAR 1904.

Any retrospect of the year 1904 that fails to include a reference to the stupendous struggle that is being waged by sea and land in the Far East would be guilty of a large omission. This is true, even when the point of view is taken, as in the present case, from a standpoint purely scientific. Much as we could wish that science were first and last the handmaiden of peace, and that the growth of knowledge and the progress of invention and discovery meant the gradual extinction of the arts of war—we cannot shut our eyes to the fact that much of the interest in the present conflict, and all of its grim surplus of carnage, is directly traceable to the deadlier weapons that our twentieth century science has placed at the disposal of the combatants.

Most sincerely does the SCIENTIFIC AMERICAN regret the fact, as disclosed by the present war, that the refinements of science, instead of mitigating, as we had many of us fondly hoped they would, the horrors of war, have multiplied them. Contrary to expectations, the struggles on land have proved that the awful destructiveness of modern implements of war, so far from restraining the opposing forces and causing them to fight at ranges at which the magazine rifle and the machine gun are not so deadly, has rather thrown them into the close embrace of death struggles, in which the hand-grenade and the bayonet are the preferred instruments of slaughter. The dream of the philanthropist that science had made modern warfare so shocking and terrifying as to render its continuance impossible, fades pitifully away in the presence of that awful panorama at Port Arthur, where the bodies of brave men lie rotting by the thousand on the snow-covered slopes of the fortifications, truce for burial being deemed incompatible with the exigencies of successful warfare. All of which goes to prove that in seeking for a cure for the madness of war, we must look rather to moral than material forces. There is a hint in this, surely, in the fact that while Russia and Japan are locked in a struggle to the death, the nations of the world, among whom is included one of the parties to that struggle, have agreed to assemble in another Peace Congress at the Hague.

RADIO-ACTIVITY.

Although considerable experimenting has been done with the radium group of minerals, it can hardly be said that the year's investigations have added much to our knowledge of the cause of radio-activity. Not a little speculating has been done as to the origin of the radium emanations, some of it mildly amusing, and some of real value. Prof. Rutherford, who has probably been the most indefatigable radium investigator of the year, if one may judge by the frequency of his contributions to the scientific press, has published a most plausible theory of the hypothetical disintegration of the radium atom, and reinforced his assertions by experimental proof, wherever that has been possible. Many of the physicists who have been working in the field have so far extended their researches that many of the substances of common life may be considered sources of rays. Notable among these men is Simpson, who has made very valuable tests of atmospheric radio-activity at high altitudes. Tommasina, too, has attracted not a little attention to himself by his discovery of the so-called "pyro" rays, given off by red-hot metal wires. These "pyro" rays bear a striking similarity to the radium emanations and like them may be classified into the well-known alpha, beta, and gamma rays.

No doubt the most puzzling physical work of the year was that carried out by Prof. Blondlot in endeavoring to convince a doubting scientific world of the existence of his N-rays. The controversy which has raged over the problematic manifestations of Welsbach burners, Nernst lamps, flint, vibrating sonorous bodies, and even such ordinary things as paper, is not likely to be settled until Blondlot consents to work with some skeptical opponent in the now famous Nancy laboratory where the rays were first discovered. Charpentier, who has assiduously advocated the existence of the N-rays, has outdone, from the standpoint of sensationalism, anything that Blondlot himself has announced. He has proclaimed in no less an organ than the staid Comptes Rendus that the nervous system of the living organism can be mapped out by means of a fluorescent screen, because the nerves have the peculiar property of rendering the N-rays unusually luminous. That it should thus be possible to measure the force of muscular contraction, to note the activity of the brain, and indeed, to trace by substances rendered phosphorescent, the general arrangement of nerves in the human system, seems an extraordinary feat.

Prof. Wood of Johns Hopkins University has made probably the most thorough inquiry into the subject, and has come to the conclusion that even the photographic proof offered by Blondlot must be rejected, because the exposures were not timed with scientific accuracy. It must be confessed, however, that Prof. Blondlot, according to information he has supplied to the editor of this journal, has repeated his photographic experiments with instruments more precise than those which Prof. Wood has so justly objected to, with the result that in his opinion the existence of the N-rays is more firmly established than ever. Although we have ourselves been inclined to give Prof. Blondlot the benefit of the considerable doubt there is in this matter, because of the unusual skill in observation that seems necessary, still we must confess that the N-rays must be studied with more exact means than those adopted by Blondlot, before they can take their place with radium, thorium, and pyro rays as new discoveries. In Great Britain and Germany, the existence of these doubtful N-rays is boldly denied. At the University of Glasgow seven skilled observers were unable to note any of the characteristic phenomena of the rays. In Germany, Prof. Lumner has ingeniously shown that many of the N-ray experiments can be imitated without employing any of the means prescribed by Blondlot, and that the effects observed may be referred to processes taking place in the eye itself. On the whole, the best that we can do is to place a question mark beside the N-rays and hope that the coming year may end a debate over which too much ink has been spilled.

CIVIL ENGINEERING.

Probably the most important event in the world of civil engineering during the year was the opening of the Rapid Transit Subway in this city. While this is not by any means the first subway built to accommodate the passenger traffic of a large city, it is certainly the first attempt to provide a genuine express service over a four-track tunnel road. The system has been in operation long enough to prove that it is possible to run an underground service of fast trains under short headway with a minimum of risk and a maximum of punctuality and general comfort—all below the surface of the ground and entirely independent of street traffic. Its success has sounded the doom of the elevated railway, as such, and most of those who read these lines will see the day when every elevated structure will be removed from our streets, and when practically all the main avenues of surface travel will be duplicated by a system of electrically-operated subways constructed beneath them. This year has seen the completion of the first of the two single-track tunnels, which will serve to connect the New Jersey surface trolley system with the underground system in New York. The second or northerly tunnel is making unexpectedly rapid progress, thanks to a new shield of excellent design, and is now nearly one-half completed. Work is in active progress on the Pennsylvania Railroad tunnels from New Jersey to Long Island; the shafts have been driven, and the tunnel excavation is under way. The huge excavation at the site of the terminal station is making fair progress; but it must necessarily be many months before it can be carried down to a uniform depth of forty feet below the street level over an area measuring 500 feet in width by 1,800 feet in length. Toward the close of the year the plans were made public of the large terminal station to be built by the New York Central Railway at the site of the present Grand Central station. This building will be unique in many particulars. It contemplates the entire separation of the express from the local service, the former being handled on the higher level of the station, on which there will be no less than forty-two parallel stub-tracks, and the local service on a lower level, about forty feet below street grade, where there will be a number of stub-tracks and a loop, the latter enabling suburban trains to be run through the terminal without switching. The station building proper will cover a block of ground measuring from 300 to 625 feet in width by 680 feet in length, and it will include a vast concourse 160 feet in width, 470 feet in length, and 150 feet in height. The operation of the trains in the station, the yard, and for forty miles of the main lines, will be by electric power, which will be furnished from two 40,000-horse-power central stations, located one on the Hudson River, and one on the East River. The past year has seen the opening of the unique system of freight subways, which has been built below the business portion of the city of Chicago. It includes a series of trunk lines running beneath the principal streets, with feeder lines extending below the cross streets, whereby freight may be taken from the terminal stations of the great roads that center in Chicago direct to the shipping floors of the various business houses. Twenty miles out of the sixty miles of tunnels comtemplated by this scheme have been completed. Limitations of space prevent any lengthy reference to the extension of the subway systems in the leading cities of Europe. The power station at Chelsea, London, the second largest in the world, built for the operation of those underground roads in London which were formerly operated by steam, is approaching completion; and excellent progress has been made in the construction of the various deep tunnel roads that are under construction below that city. Work has also been prosecuted vigorously on the ambitious scheme of subways laid out below the city of Paris; and care is being taken, both in the construction of station exits, and of the rolling stock, to provide against a repetition of the loss of life by fire and suffocation which occurred last year. Although several bridges that will be among the largest in the world are under construction, none of them have been opened during the past twelve months. These include the monumental, bridge at Quebec, crossing the St. Lawrence, which when completed will contain the longest span, 1,800 feet, of any bridge in existence; the cantilever bridge over the East River, at Blackwell's Island, which includes two notable river spans, one 984 feet long, and the other 1,182 feet in length; and the Manhattan suspension bridge over the East River, with a main span of 1,470 feet and a suspended floor of 120 feet in width. The piers and anchorages of the former bridge are completed, and the erection of the steel work is about to begin. Of the Manhattan suspension bridge, than which there is not a great engineering structure in the wide world more urgently needed, nothing has been completed beyond the masonry piers, and three years of valuable time have been lost as the result of this great work being made the mere sport of municipal politics. The preliminary investigation of the Panama Canal Commission has resulted in the agitation of the question of building a sea-level canal, as originally planned by De Lesseps. The surveys have shown that it is possible to divert the floods of the Chagres River to the Pacific by cutting an eight-mile tunnel through the divide; and although a sea-level canal will cost fifty per cent more, and take twice as long to build, as a canal with locks and a 90-foot summit level, the indications are that this will be the plan finally accepted.

STEAM AND ELECTRICAL RAILROADS.

The statistics of the steam railroad system of the United States show that over 4,000 miles of new road was built last year, bringing the total up to the remarkable figure of about 207,000 miles, on which the annual traffic receipts amount to nearly $2,000,000,000, and the net receipts to nearly $700,000,000. Apart from the pending introduction of electric in place of steam haulage on trunk railroads, there is nothing strikingly new to record, either in the construction of the roadbed or in the equipment of our railroads. The really stupendous work of relocating and reconstructing the western transcontinental roads, and, to a less extent, some of the eastern roads, has been prosecuted during the year, though on a more moderate scale than characterized the year preceding, the Pennsylvania system in particular having greatly reduced its expenditures for reconstruction. The size and weight of rolling stock appears to have about reached its practical limit, at least as far as passenger and freight cars are concerned. Not so however with the motive power; for at the St. Louis Exposition there were shown two freight locomotives, one of which, a Baldwin tandem-compound type built for the mountain division of the Santa Fé system, weighed 287,240 pounds; while the other, built by the American Locomotive Company for the mountain division of the Baltimore & Ohio Railroad, weighed 334,500 pounds. The coming type for express passenger service is the four-cylinder, balanced compound, either of the De Glehn type, with the pairs of high-pressure and low-pressure cylinders driving on separate axles, or of another type, that finds much favor, in which all four cylinders connect to a single axle. The former system is represented in this country by the Cole engine, as used on the New York Central, and the latter by the Baldwin type, as built for the Chicago, Burlington & Quincy Railroad. The speed of passenger trains has accelerated somewhat during the year, but it has evidently about reached the limit, at least under steam traction. In the speed and number of trains run the English and French services are greatly in advance of ours in the United States, although there are no trains in Europe that have so high a scheduled running speed as those that are put in service between Philadelphia

and Atlantic City during the summer season. As the result of the construction of more powerful locomotives for their express trains, the English railroads have again taken the lead in fast running, for they now maintain in regular service a total of fifty-three daily trains scheduled to make a speed of 55 miles an hour and over from start to stop, the speeds ranging from 55 miles to 61.7 miles per hour. France has a total of thirty-five daily express trains with schedule speeds of from 55 to 60.8 miles per hour. Mention should be made of the run on the Great Western Railway, England, made during the year, when a train took the American mails from Plymouth to London, a distance of 246¾ miles, at an average speed of 65.49 miles per hour for the whole journey, the last 36 miles being covered at a rate of 79.17 miles per hour. The great weight of American express trains prohibits any such speeds as these in regular everyday service, but with the advent of electrical traction on our trunk railroads it is probable that we shall take the lead in express service.

This brings us to the question of the application of electric traction to the trunk lines, not merely for their suburban service, but for long-distance travel between widely-separated centers. Pioneer work on a most ambitious scale has been begun by the New York Central in the electrifying of its terminal station and suburban traffic. Undoubtedly the most interesting feature of this work is the fact that the express service will be operated electrically for a distance of forty miles out of New York; and upon the results obtained with the powerful electric locomotives now being built at Schenectady will depend, to an extent that cannot just now be definitely stated, the question of the extension of electric traction over such stretches of road as lie between New York and Chicago, Boston, Pittsburg, and Washington. In this connection mention should be made of the competitive trials now being carried out in Germany between steam and electric traction over the Berlin-Zossen stretch of road, on which a speed of 131 miles an hour was reached by an electric car in 1903. Several high-speed express locomotives of special design are being tested; but up to the present time there have been no results that would give reason to believe that for hauling heavy trains at speeds of 80 to 100 miles an hour the steam locomotive can compete with electric traction.

On the other hand, the results already obtained during the experimental runs of the New York Central electrical locomotive on a six-mile stretch of their track near Schenectady are very satisfactory. The trial track is only six miles in length, and consequently there is not time for the locomotive to reach the limit of its acceleration when hauling trains of different weights; but the data thus far secured prove that this electrical locomotive has all the powers of rapid acceleration which is one of the best features of this form of traction. Its total weight is 95 tons; its maximum horse-power, 3,000; and the maximum drawbar pull is 32,000 pounds. It is of the gearless type, that is to say, the armatures are mounted direct on the axles, and the field magnets are rigidly connected to the frame. Already, in the course of the tests, a speed of 63 miles per hour has been reached with an eight-car train, and 72 miles per hour with a four-car train; and in the starting test a speed of 30 miles per hour has been reached in 60 seconds with an eight-car train, weighing with the locomotive 431 tons, which is an acceleration of one-half mile per hour per second. With a four-car train weighing with locomotive 265 tons, the acceleration was at the rate of 0.8 of a mile per hour per second. If we remember that this locomotive was built to do certain work and no more, we can see what possibilities of increase in the weight of trains and in the running speeds exist in the electric locomotive. This engine weighs 95 tons, and can possibly develop a maximum horse-power as high as 3,500. It would be quite feasible to build a locomotive for high-speed service, of 5,000 horse-power and 125 tons weight, that would not overtax the track and bridges. However, if the New York Central venture leads to the general electrification of the trunk road for long distances, it is probable that the Sprague system of multiple-control, with the motors on the car axles, will be preferred. Meanwhile the trolley road systems throughout the country are gradually approaching the steam railroads in the solidity of their tracks, the size of their rolling stock, and the general comfort of travel. Already on interurban roads the electric sleeping car and the electric dining car have made their appearance, and are giving good satisfaction.

MERCHANT MARINE.

There are several respects in which the year just closed is a notable one in the annals of the merchant marine. In this country we have seen the putting into commission of the "Minnesota," the first of two huge American-built freight and passenger steamers of the type that is now becoming so generally popular. This vessel is 630 feet long, 73 feet broad, and 56 feet in molded depth, with a displacement at a draft of 36½ feet of, say, 35,000 tons. These two vessels will ply on the Pacific between Seattle and Oriental ports. Another notable vessel of the same type is the "Baltic" of the White Star Line, which made her maiden trip to this port during 1904. With a length of slightly over 725 feet, a beam of 75 feet, and a molded depth of 49 feet, this vessel has a total displacement at maximum draft of 40,000 tons, and she is at present, on every point of comparison, the largest ship in the world. The most important event of the year, perhaps, was the recommendation of the expert commission of the Cunard Company that turbine engines be installed in the two new Cunarders, and the letting of the contract for building these vessels, each of which will cost about six and a half million dollars. The money for their construction is loaned by the British government, which has the privilege of taking them up at short notice for use as armed cruisers. The latest authentic figures regarding the dimensions of these ships are as follows: Length over all, 790 feet; beam, 87½ feet; molded depth, 60 feet; horse-power, 75,000, distributed among four shafts. The speed will be 25 knots an hour; but judging from the excellent results obtained in recent vessels propelled by turbines, it is not unlikely that 26 knots will be reached on the trial trip. The year has seen the launch of the "Victorian," the first ocean liner to be equipped with turbines; and the vessel will make her maiden trip some time during the present year. Mention should also be made of the passage of the turbine-propelled freight and passenger steamship, the "Loongana," from Glasgow to Australia in thirty and a half days, the speed varying from 16 to 18 knots an hour. The turbines showed superior economy, and an all-round greater efficiency in service of this character over the ordinary reciprocating engines.

NAVAL AND MILITARY.

The lessons of the Russo-Japanese war are bound to have a marked effect upon the design of naval and military war material. Already, indeed, the naval campaign has shown its effect in the latest designs for warships authorized by various governments. It is not our intention at this time to give any *resumé* of the events and lessons of this conflict, and we shall reserve such matter for an article in our succeeding issue; but we may here point out that the tactics of the Japanese in electing to fight their naval engagements at extremely long ranges, frequently twice as great as that employed during the battle of Santiago, has shown the great value of high-powered ordnance, especially if it is mounted on a ship that possesses superior speed. It is the carrying powers of the big gun that render accurate and destructive long-range shooting possible; and if the ship that mounts the heavier artillery also possesses higher speed, she can choose her distance and play upon the enemy without his being able to make an effective reply. This was done by the Japanese, both in the engagement between battleships on August 10, and the engagement between armored cruisers a few days later. Consequently in the latest designs for British battleships of the "Lord Nelson" class, the 6-inch gun is abolished altogether, and the armament consists of four 12-inch and ten 9.2-inch, all carried in turrets on the upper deck, with a command of from 22 to 26 feet above the waterline. The new Japanese battleships have four 12-inch, four 10-inch, and twelve 6-inch guns. The latest Russian battleships now building in the Baltic are to carry four 12-inch and twelve 8-inch guns, and it is not unlikely that our next new battleship designs will provide for four 12-inch and ten 10-inch guns, all in turrets. The war has brought about some marked changes in the relative standing of the navies of the world. At its opening Russia stood third in a comparison on paper of naval strength. To-day she has lost seven battleships, four armored cruisers, seven protected cruisers, and several gunboats and destroyers, of a total displacement of about 175,000 tons; and these ships are the very cream of her navy, being of her latest construction. This loss forces her to drop from third to fifth position. If the Baltic fleet should be sunk or captured, which certainly is not unlikely, it will mean that her modern navy is absolutely wiped out of existence, and that she will have to begin *de novo* in the construction of another. At present the ranking of the naval powers is Great Britain, France, Germany, United States, Russia, Italy, Japan. If all the ships now building were completed, the order would be Great Britain, France, United States, Germany, Russia, Italy, Japan. There has never been a year in the history of the United States navy when so large an addition was made to our naval strength. This is due to the fact that many of the ships that were launched or put in commission this year should have been delivered from one to two years earlier. Among the launches are such fine vessels as the battleships "Louisiana" and "Connecticut;" the battleships "Georgia," "Nebraska," "Rhode Island," and "Virginia," of the "Georgia" class; the "California" and "South Dakota" and "Tennessee," of the armored cruiser class, and the protected cruisers "Milwaukee" and "Charleston." The speed trials of our later ships, particularly the armored cruisers, have been quite satisfactory, and altogether the progress of construction is far more rapid than it was two or three years ago. There has been no change of great moment in our naval ordnance, which continues to be manufactured on the patterns brought out during the administration of Rear-Admiral O'Neil as Chief of Ordnance. These guns have a designed velocity of 2,800 and 2,900 feet per second, on paper, and probably they are good for a service velocity of 2,700 feet per second. The service charges have been somewhat reduced by a general order sent out during the year. A new 45-caliber 12-inch piece is being built, which will be one of the most powerful 12-inch guns in existence. In speaking of the tendency to introduce heavier-caliber guns in the secondary battery, it is gratifying to reflect that this has been the practice in our navy ever since the period of reconstruction set in in the early eighties. The 8-inch gun has ever been a prominent weapon on United States battleships. It is probable that in the future our ships will settle down to three standard types—battleships of 16,000 to 18,000 tons, armored cruisers of from 14,000 to 16,000 tons, and swift scouts of 24 to 26 knots speed and of about 4,000 tons displacement. So swift has been the development of this new classification, that we have on our hands a miscellaneous lot of nondescript vessels, such as the 16-knot cruisers of the "Denver" class and the poorly-protected vessels of the "Milwaukee" and "Charleston" class, which it is safe to say will never be duplicated in our future building programmes. The torpedo boat has been shorn of much of its terrors during the present war. Vigilance, eternal vigilance, is the best defense against its attack, and its value, like that of the submarine, will in the future be rather moral than material.

STEAM ENGINEERING.

In a review of the most important events in steam engineering during the past year, we are confronted at once with the fact that the steam turbine looms up more strikingly than ever as the prime mover of the future in many specified lines of work. Elsewhere in this review we have spoken of its rapid strides in the merchant marine, for which it is admirably suited. As compared with the reciprocating engine, it is at a disadvantage when running under light loads, and this is particularly noticeable in marine work. The report, given out by the British naval authorities, of comparative trials of identical cruisers fitted with reciprocating engines against a similar cruiser fitted with turbine engines, showed that although at speeds of 14 knots and under the turbines were less economical, at speeds above 14 knots they showed a superior economy which, as maximum speed was approached, was simply astonishing. The maximum horse-power developed by the reciprocating engines was 9,600, and the maximum speed 22.24 knots. The turbine engines showed a maximum development of 14,000 horse-power, and a maximum speed of 23.63 knots an hour. The coal consumption at these speeds was 2.65 pounds per horse-power hour for the reciprocating engine, and 1.74 pounds per horse-power hour for the turbine engines. With 750 tons in their bunkers, the reciprocating engine cruiser could steam for 2,140 knots at 20 knots an hour, whereas the turbine-driven ship, at the same speed, would not exhaust her whole supply until she had covered 3,160 knots. The results obtained in land service have been equally favorable. The reliability of the type was shown in the 600-horse-power Westinghouse-Parsons turbine, that was exhibited in the Machinery Building at the World's Fair. This engine was started on June 20, and ran continuously at a speed of 3,600 revolutions per minute, and under great fluctuations of load, until it was stopped on December 2. On opening the machine it was impossible to detect any signs of wear whatever. In central station service, the turbine has now established itself as the accepted type of drive for the electric generator. The most prominent types in this country are the Parsons and the Curtis, and in Europe the Rateau. They are being built in units of as high as 11,000 horse-power each, and the new power stations to supply current for the electrical operation of the Pennsylvania and New York Central Railroad systems in this city are to be equipped entirely with steam turbines. In general reciprocating engine practice there is a tendency toward the use of higher steam pressures and the more extended application of superheat, hot forced draft, and other refinements for producing a high economy.

AERIAL NAVIGATION.

In that most fascinating and difficult field of experiment, aerial navigation, there has been much activity, but very few results of a satisfactory nature; that is to say, results that would lead us to regard the practical commercial airship or aeroplane as a possibility of the near future. Dr. Barton, whose aeroplane balloon is one of the largest and most powerful yet constructed, suffered from an accident which seems to have prevented his putting his airship to the test. Santos-Dumont, who entered his latest machine for the contests at the St. Louis Fair, was the victim of treachery at the hands of some unknown person at St. Louis, and carried his mutilated airship back

(*Continued on page 6.*)

A CHAINLESS TWO-SPEED BICYCLE.

Notwithstanding the aversion that bicyclists have for back pedaling, the Manufacture Francaise d'Armes et Cycles of Saint Etienne, France, taking as a basis the fact that back pedaling entirely abolishes the dead point, more rationally and completely utilizes the motor muscles, and gives greater efficiency than direct pedaling, has just constructed a very interesting two-speed and free-wheel machine. The two speeds are obtained instantaneously, automatically, and while running, with a single chain without gearing or controlling mechanism.

It is, upon the whole, an ordinary bicycle, but one in which the chain runs over two sprockets instead of one and gives, without supplementary friction, one speed by pedaling in the usual manner and another by back pedaling. For changing the gear, it suffices to change the direction of pedaling, an operation that may be performed instantaneously and so easily that it is possible to pedal one revolution forward and one backward, that is to say, to change the gear at every instant without any interruption in the operation of the machine. If the cyclist stops pedaling, the chain and sprockets will remain immovable and the machine will come to a standstill.

Thanks to a special arrangement of the pedal bracket, the chain never pulls obliquely, but always directly, that is to say, parallel with the axis of the machine. Besides, it is only one of the halves of the chain that

A SIMPLE TWO-SPEED BICYCLE.

works. In direct or forward pedaling, it is the upper half, and in back pedaling, the lower. All the rest of the chain is slack and runs idly as in an ordinary bicycle. The small wheel merely supports the chain and reverses its motion. It is therefore submitted to no stress, and, as it serves to regulate the tension of the chain, there is no need of two rear stretchers, and the wheel is not apt to get out of order.

This new machine weighs but a few ounces more than an ordinary bicycle, and all its parts are handsome, very simple, exceedingly strong, and of careful construction. It offers, in fact, an ideal solution of the problem of a bicycle having two speeds and an automatic change of gear which is exceedingly simple and inexpensive.

A BAD CASE OF GUN EROSION.

The high velocities and increased energy of modern guns have not been obtained without the sacrifice of other desirable elements in the gun. The most serious trouble that confronts the modern artillerist is the tendency of the smokeless powders, that are now exclusively used, to burn out the interior lining of a gun, particularly near the powder chamber. The powder itself is the cause of more or less anxiety because of its chemical instability. In our own navy we have recently seen the issuance of an order to reduce the charges in all guns using a certain brand of powder, of which extensive shipments had been made to our various vessels.

But that is another story. The erosion, or burning out, of the interior tube of the gun, which is that portion in which the rifling is cut, and which is in immediate contact with the powder gases, is due to the high pressure and intense heat of the powder gases. At the instant that a charge is fired, even in the case of modern, slow-burning powder, a great volume of gas is generated, and being confined in the powder chamber by the projectile, its pressure rises to an enormous figure which, in the case of the service charges in the United States guns, is as high as 17 tons per square inch. This is accompanied by a proportionate rise in the temperature of the gases. If it were possible to look into the powder chamber at the instant of discharge, it would be found to be at a dazzling white heat. As the projectile begins to move down the bore of the gun, these white-hot gases rush out of the powder chamber, and as they stream from the larger chamber into the smaller bore, they literally melt the hardened steel surface of the bore, the process being probably assisted by some chemical reaction not yet thoroughly understood. This erosion is further assisted, and, indeed, perhaps is primarily produced by the imperfect obturation or sealing by the copper rifling band of the space between the projectile and the walls of the gun. The gases, under the enormous pressure, quickly find out the very smallest way of escape past the base of the shell, and they stream at an enormous velocity, and still at a white heat, through any such slight opening, and melt the hard steel of the gun just as a stream of steam or hot water would cut its way through a block of ice.

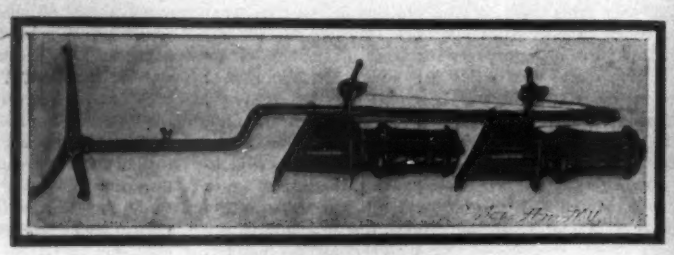
It must not be supposed, however, that all modern guns, after firing 176 rounds, would be in the parlous state of the gun from which the specimen shown in our engraving was taken. This gun was an English piece, and it is well known that the English artillerists have had great trouble from erosion because of the quality of powder which they use. This powder is known as cordite, and the erosion is the price which the English pay for certain desirable qualities which are absent from other powders that do not cause so much erosion. Cordite consists of 58 parts of nitroglycerine, 37 parts guncotton, and 5 parts vaseline, and it is the large amount of nitroglycerine that is responsible for the serious eroding effects mentioned above. Bulk for bulk, the English powder is much more powerful than the United States navy powder; and according to Admiral O'Neil, the late Chief of Ordnance, it requires only about half the weight of the charge for a given gun as compared with the nitro-cellulose powder used in our own guns; consequently, there is a great reduction in the weight of ammunition, and a given number of charges will make a proportionately smaller draft upon the displacement of a vessel, while the individual charges are easier to handle at the guns. On the other hand, with the nitrocellulose powder, the life of the guns is very much longer. Indeed, the erosion trouble has been practically eliminated from the guns of our own navy. The English, however, consider that in view of the advantages of lightness and compactness, it pays in the long run to use a high nitroglycerine powder, and reline guns when they become sufficiently eroded to impair their accuracy. They claim that the operation of relining, as practised in their gun factories, is not such a difficult or tedious operation as might be supposed.

We must confess to feeling a strong prejudice against the use of a powder that commences to destroy the gun from the very commencement of its active service. On the other hand, the Japanese are using the English type of ordnance, and although they have developed a new powder of their own at their home factories, we believe that it is a high-temperature powder of the same general character as the English cordite. The present war should serve to give some very valuable data on this most important subject.

Most of the feldspar used for pottery purposes is orthoclase, or the potash variety, which is found in granite, gneiss, syenite, and mica schist. The basic or lime-soda feldspars are generally associated with dark-colored minerals from which they cannot be easily separated.

NEW PHOTOGRAPHIC LAMP.

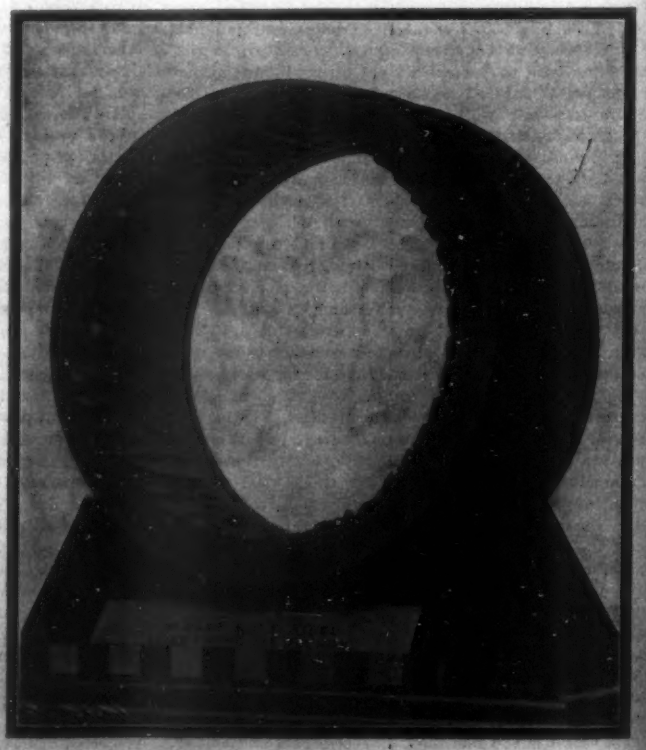
The "Regina" arc-lamp manufactory at Cologne has recently constructed a new type of electric lamp that remedies the manifold inconveniences of the ordinary arc lamps employed for photographic purposes. Of



NEW PHOTOGRAPHIC LAMP.

such inconveniences, one of the least is the production of ashes and poisonous gases. The light given by a single lamp lacks steadiness, thus producing variations in the exposures, and making it necessary to employ several lamps at once. Now, lamps generally consume 40 amperes at 110 volts, and this, in an exposure of 10 minutes, say for a tracing, represents 0.73 kilowatt-hour per lamp and per tracing. Under such circumstances, each copy costs, merely for the exposure, from 20 to 40 cents. With the Regina copying lamp of the latest type, things are different. This apparatus, with the exceptionally long period of 250 hours lighting with a single carbon, permits, through a proper limitation of the entrance of air, of utilizing nearly the whole of the energy in chemically active light. The arc lamp is employed on voltages as high as possible, and the arc has a length of about one inch. There is thus obtained a very great number of active luminous rays. There is evidently a great saving in the current, and the work, it appears, is done five times as quick. With a current of 4 amperes at 220 volts, that is to say, for an energy of 880 watts, the new lamp is, photographically speaking, as efficient as an ordinary arc lamp that consumes 70.4 amperes at 55 volts, or 3,872 watts. According to the experiments that have been made, it requires from 3 to 10 minutes to obtain an excellent copy of a blue print with a consumption of 880 watts. Reckoning the kilowatt-hour at 15 cents, the cost of exposure is reduced to from 1 to 2 cents. The cost would evidently be much less in a private electric installation.

During the contract trials of the new British battleship "Dominion," the latest acquisition to the "King Edward VII." class, a speed of 19½ knots was attained. This is the highest speed that has ever been realized by a vessel designed by the Admiralty when running over a measured course. For this trial the engine room was closed down, all bulkhead doors were closed, the staff in charge was limited to ordinary battleship complement, and every condition was exactly the same as if the ship were actually in action.



Section of Inner Tube of an English Gun, Showing the Erosion by White-Hot Powder Gases.

A BAD CASE OF EROSION.

THE MANUFACTURE OF MACARONI.

BY W. FRANK M'CLURE.

Macaroni, vermicelli, stelliette, and other paste foods originally made in Italy, are manufactured from kinds of wheat which contain a goodly per cent of gluten. The flour obtained from these kinds of wheat, when mixed with water, forms a peculiar dough. In America the mixing is done by modern machinery, and this operation is followed by that of mechanical kneading, which results in producing a firm, hard paste. A typical macaroni mixing and kneading room is pictured on this page.

The Mixing and Kneading Room.

The flour is dumped into the mixing vats by the sackful, and hot water by the bucketful is added. The stirring is done by means of revolving machinery in these vats, and is continued until the mixture takes the form of dough. This dough is rolled upon a flat surface by a large stone or iron weight, which, like the mixing machinery, revolves. The stone weights are somewhat antiquated, as they require an attendant's efforts to keep the dough in proper position. The metal weights are ingeniously equipped with teeth, which keep the dough constantly in place. The kneading operation requires about a quarter hour's time. Experienced Italians are, in many factories, in charge of all the processes.

The firm, hard paste from the kneader is removed to double-cylinder presses, in which it is forced downward through copper dies. On the size of these dies depends the size and shape of the finished product. Vermicelli comes from the press in mere strings or shreds. The diameter of the ordinary macaroni, which is in the form of a hollow tube, is well known to everyone. Then there are the fancy shapes squeezed from a horizontal press. Other forms of the product of a macaroni factory are mere chunks or noodles.

The lengths of macaroni or paste foods are almost as varied as the thicknesses. The macaroni which is coming from the press shown in the photograph is cut off by the attendant, knife in hand, at intervals of four or five feet. Vermicelli may be but six or eight inches in length. In connection with the horizontal presses, from which come the short lengths and fancy shapes, there is a knife which works automatically.

The long strips of macaroni, after coming from the presses, are placed evenly over racks. The racks are then hurried away to the drying rooms. The short fancy shapes are dried and cured upon trays. Mechanical fans assist in all drying operations. Before curing, the strips of macaroni are sometimes placed beneath blankets to moisten them. This keeps them from subsequently cracking in the curing room. In the cool air of the curing room, the macaroni is allowed to remain nearly a week, and then it is ready for packing. Before packing, the long strips are carefully inspected, and any that is found defective is placed by itself and sold for a less price. The perfect strips are packed in long boxes and shipped to the jobber. The processes of drying and curing may differ slightly in different factories or in the making of different kinds of macaroni. In some instances, the drying must proceed more slowly. Some may have wondered why macaroni, where larger than strings or shreds, is made hollow. The reason is that it may cook more uniformly. Those engaged in the making of macaroni in the United States report a steady increase in the demand for this commodity. This increase does not come wholly from among the foreigners, but from Americans as well, who are fast learning to like a food which has been universal among Italians far back in history. There are numerous factories in the United States, using in the neighborhood of fifty barrels of flour per day in the manufacture of these paste food products.

The encyclopedias tell us that macaroni was originally but lumps of paste and cheese squeezed into balls. In its infancy, the manufacture of macaroni was one of the chief industries of Genoa, and the wheat for its production was brought in largest quantities from Sicily. A long time ago in Italy the dough or paste was rolled into sheets, and the designs were stamped from these sheets.

An Electrolytic Telephone.

In connection with the Jubilee Exhibition held by the German Electrical Society, in Berlin, at the end of November, Mr. E. Ruhmer exhibited a rather curious apparatus in the shape of a novel telephone receiver (the electrolytic telephone). This remarkable apparatus, which could be called a "speaking accumulator," consists mainly of an electrolytic cell, including electrodes of unequal size. On being traversed by microphone currents, this cell renders truly any words spoken into the microphone to which it is connected. By means of two hearing tubings, similar to those of a phonograph, the words spoken at the sending station may be perceived with a high distinctness.

A Shadow Clock.

A clock which seems to be pre-eminently adapted for the sickroom or hospitals is the invention of Prof. Hirth, of Munich. It consists merely in the depression of a button, which cuts in a small electric lamp placed under the dial of an electrically-illuminated clock, throwing the shadow of the face and its hands upon the ceiling in a highly magnified state. Viewed from the bed of a reclining invalid, it obviates the irksome craning of the neck.

Macaroni Presses.

Room in Which the Macaroni Is Inspected and Packed for Shipment.

THE MANUFACTURE OF MACARONI.

(Continued from page 3.)

to Europe in disgust. Perhaps the most persistently active of all the airship inventors is Lebaudy, who, with his new machine, No. 2, has made altogether some fifty ascents. To him is due the credit of having accomplished the longest continuous trip on record. The much-advertised airship contests at St. Louis proved to be a miserable fiasco. In view of the results it cannot be denied that the management, in placing a speed limit of not less than 20 miles an hour upon competitors, was guilty of a grave mistake; for it was certain beforehand that, in the present state of the art, no machine could be built with a reasonable expectation of complying with such a restriction. The only really creditable work done at St. Louis was the successful flights made by the Baldwin machine. Of the aeroplane we have heard comparatively little during the year. Baden-Powell has continued his gliding experiments, and is gathering much useful data for future work. The Wright Brothers, in this country, who in 1903 made the first successful flight with an aeroplane, self-propelled and carrying its operator, have recently made a flight, the particulars of which have not been given to the public. Mention should be made in this connection of the successful experiments made by the French and Italians with what are known on the Continent as "*ballons sondes*." These are small balloons furnished with self-registering meteorological instruments—barometers, thermometers, etc.—which are set free and rise to enormous heights. They contain a notice to the finder that on their being returned to the sender a specified reward will be given.

AUTOMOBILE AND MOTOR BOAT.

The past year has seen a greater development of the automobile, at least in the industrial sense, than any of its predecessors. Out of the motley variety of types, shapes, and sizes that were developed during the earlier growth of the industry, there have survived certain desirable types and makes which will probably be the standards for at least several years to come. The accepted type of racer is a machine of from 60 to 90 horse-power, with vertical cylinders carried above the front axle with a bevel-gear drive direct to the rear axle. The 24-horse-power tonneau touring car seems to be accepted as the maximum-powered machine for touring and general pleasure purposes. The possession of the wonderful track at Ormond Beach served for a while to bring the records for high speed to this side of the Atlantic, and Mr. Vanderbilt's record, made on a 90-horse-power Mercedes, of 1 mile in 29 seconds, and 50 miles in 40 minutes 49 4-5 seconds, must long remain as one of the most notable high-speed achievements in the history of the automobile. Very creditable was the performance of Rigolly, who, on a 100-horse-power Gobron-Brillié machine, covered the mile with a standing start in 53 3-5 seconds. The Gordon Bennett race, over a course 327.4 miles in length, was won by Théry, who made an average speed of just under 60 miles an hour for the whole distance. At the Ostend races Haras, on a Darracq machine, eclipsed Rigolly's performance by covering the mile from a standing start in 48 3-5 seconds. The supreme speed effort of the year was achieved in these races, when Rigolly covered the flying kilometer at a rate of 103¼ miles per hour. America is rapidly becoming a strong competitor of Europe in the production of racing cars. Evidence of this is seen in the track records made by Oldfield late in the year, when he made the mile in 52 1-5 seconds and the 10 miles in 9 min. 12 3-5 sec., easily beating Théry, the winner of the Gordon Bennett race of 1904. The records on the race course find their counterpart in some excellent endurance performances on country roads, chief among which is the transcontinental trip from San Francisco to New York, made by two men in a 10-horse-power air-cooled runabout, in the short time of thirty-three days, which is twenty-eight days less time than was occupied in the previous fastest trip. The distance covered was 4,500 miles. Toward the close of the year the very successful Vanderbilt cup contest was inaugurated by a race on Long Island over a course on which the actual racing distance was 284.4 miles. The race was won by a Panhard 90-horse-power machine, which maintained an average speed of 52.2 miles an hour for the whole distance.

Closely allied to the automobile is the motor boat; for the latter owes its origin to an enthusiastic French automobilist, who conceived the happy idea of putting a high-powered automobile engine in a lightly-constructed shell, and directing the craft with a regulation auto steering wheel. The idea "caught on" at once, and out of this venture has developed the speedy craft of to-day. The events of the year were the race off Cowes for the Harmsworth cup, which was won by the French boat "Trèfle-a-quatre"; and the race for the gold challenge cup of the American Power Boat Association, won by the "Vingt-et-un." Mention should also be made of a race from New York to Poughkeepsie, which was won by a boat called the "XPDNC" in 5 hrs. 11 min. and 50 sec. at an average speed of 26.29 statute miles per hour. The "Ouontic," a new American boat of 175 horse-power that was completed late in the year, on her trial trip covered the mile at a speed of 23.42 statute miles per hour. The improvement of the motors, particularly as to their reliability, has greatly stimulated the motor-boat industry, and apart from the interest which will be aroused by future high speed contests, there are indications that the cruising motor boat will ultimately rival, if it does not exceed, the sailing yacht in popularity.

WIRELESS TELEGRAPHY.

During the past year wireless telegraphy has continued to establish itself as an art of assured commercial value and practicability. The Marconi system in England, Italy, and to a certain extent in the United States, the Slaby-Arco Company in Germany and Russia, and the De Forest Company in this country have greatly extended their field of operations, and with one or other of these concerns the various governments have made some substantial contracts. De Forest has brought out a new telephonic receiver of great sensitiveness, which consists of a small metal cup filled with dilute acid into which projects a fine platinum wire, 35-1,000,000 of an inch thick. This cup and wire forms part of a local battery circuit which includes a telephonic receiver; and the electrical surgings set up in the receiving antenna, acting on the apparatus, intermittently interrupt the current in the local circuit and thus act on the telephone. Another twelve months has passed without our seeing a fulfillment of the promised transatlantic service of the Marconi Company; although we are assured that occasional experimental messages are passing between the Poldhu station and that at Glace Bay. We understand that Marconi, in common with all inventors, is chiefly occupied in the endeavor to solve the difficult problem of syntonizing, which has for its object the sending of messages exclusively to a particular station, without the possibility of being interrupted or read by competitive systems. Apparently this problem is to-day as far from solution as it was last year. Mention should be made in this connection of the Delany system of rapid telegraphy, in which the inventor has overcome the obstruction arising from the static capacity of the line, which acts to retard the current and produce an afterflow at the receiver. This difficulty is overcome by sending two short impulses of opposite polarity for each dot and dash of the Morse school. Prof. Majorama, in Italy, has brought out a new system of telephony, in which he makes use of a spark gap of the frequency of 10,000 per second. This frequency is disturbed and interrupted by the oscillations of the human voice at the sender, and the Hertzian waves are thus modified at the receiving station, so as to reproduce distinctly every word spoken in the transmitter. Another charming invention of the year is the telecryptograph, by which it is possible for the sender to dispatch his message by using an ordinary typewriter, the action of which serves to write a corresponding message on a typewriter attached at the other end of the line.

THE LARGEST WATER TURBINE IN EXISTENCE.

At a point on the St. Maurice River, some 34 miles to the northeast of Montreal, are located the beautiful cascades to which the Indians, seeing in them a resemblance to the glittering bead and quill work of the people, have given the name of "Shawinigan." The total descent of the water is 140 feet, and the site forms one of those ideal spots for hydraulic development, of which nature has made such abundant provision in North America. As if to render the task an inviting one to the locating engineer, nature has provided in the river just above the cascades a broad bay or upper lake, and just below the cascades, which turn through an angle of about 90 degrees, there is a second or lower lake. The bend in the river brings the upper and lower water levels within a short distance of each other, thus inviting the location of a power house at the bottom of the slope. From the south end of the upper lake or forebay, a canal 20 feet deep and 1,000 feet long leads to a point where the ground begins to fall through a vertical height of 140 feet in a horizontal distance of 500 feet. Here the canal is closed by a concrete wall, which is pierced by six outlets for as many penstocks, each 9 feet in diameter. Provision is made for such further extension of the wall and addition of the penstocks as future developments may call for. At present three penstocks are in position, carrying water to as many turbine wheels in the power house on the shore of the lower lake. Each penstock supplies a 6,000-horse-power, horizontal-shaft turbine, direct-connected to a 3,750-kilowatt revolving-field generator, giving a quarter-phase 2,200-volt 30-cycle current. The wheels run at 180 revolutions per minute, and provision is made for a 2½ per cent loss in the generators and a 15 per cent overload.

At the present time the capacity of the station is being enlarged by the addition of a fourth turbine, which is now being installed by the I. P. Morris Company, of Philadelphia. This turbine is the largest which has ever been constructed. It has a capacity of 10,500 horse-power, and its huge dimensions are well shown by the photograph on our front page, which was taken early last October, after the machine had been erected in the shops. It is of the horizontal-shaft, inflow type, with spiral casing and a draft tube on each side, through which the water discharges outward from the center. The water enters the turbine through the intake, 10 feet in diameter, at the bottom of the turbine. It flows around and fills the outer special tube, and then passes in radially through an annular gate, and through the wheel, and, diverging, finally discharges right and left through two large draft bends, one on either side, of which one is shown in the photograph. In these bends are situated the bearings for the shaft, one of which is clearly visible in the view shown. It will be noticed that although the diameter of the intake is 10 feet at the bottom, the sectional area gradually diminishes as the water passes around the tube, the diminution being proportionate to the amount of water that flows in through the wheel as its circumference is traversed.

The dimensions of this vast machine are as impressive as the photograph. It is 30 feet from base to top; 22 feet wide over all, and 27 feet from center to center of the two shaft bearings. Its total weight is 364,000 pounds. The shaft, which is of forged steel, is solid and weighs 10 tons. It is 32 feet 3½ inches long, 23 inches in diameter at the center, and tapers to 16 inches on the generator side and 10 inches diameter on the other side. The runner or wheel, which is the rotating part of the turbine, is of bronze, and weighs 5 tons. The quantity of water used when the turbine is operating under full load is enormous, no less than 400,000 gallons passing through per minute. Just what this figure amounts to, will be understood when we state that it represents a river 190 feet wide, 9 feet deep, and flowing at the rate of 60 feet per minute. In spite of its size, this huge machine was built in no less than five months, the contract being signed May 19, 1904, and the photograph taken October 2 of the same year.

The present output of power from the Shawinigan station is 22,500 horse-power, and of this about 10,000 horse-power is transmitted 84 miles over long-distance lines to the city of Montreal, where it is used for street railway, electric lighting, and general power purposes. The remainder is taken by local users for similar purposes and for electrolytic processes. The current is stepped up at Shawinigan from 2,200-volt quarter-phase to 50,000-volt three-phase. The transformers were so designed that they may, if desired, be operated at 56,000 volts pressure. It is a fact worth noting that the wilderness of five years ago in the neighborhood of the falls has been transformed into the substantial city of 5,000 inhabitants of to-day.

The Current Supplement.

The current SUPPLEMENT, No. 1514, opens with a splendid article by Howland Gasper on duck raising, which is a large and lucrative industry on Long Island. For the first time the whole history of one of the great national sites of Egypt has been opened before us, dating from the beginning of the kingdom and ending with almost the last of its native kings. The meaning of this revelation is tellingly recounted by the well-known Egyptologist, Prof. Petrie, in an article entitled "The Ten Temples of Abydos." John A. Morris presents an interesting study of the spider. Articles of no great length but of much practical value are those on "Tarring Roads to Prevent Dust and Aid in Their Preservation," "Compressed Air in Hoisting," and "Electric Igniters for Gas Engines," the last by the late George M. Hopkins. Prof. Ritchey's excellent monograph on the "Modern Reflecting Telescope and the Making and Testing of Optical Mirrors," is continued, the present installment dealing with polishing and polishing tools. Sir Oliver Lodge's recent discussion of "Lightning Pictures" is reviewed. The Paris correspondent of the SCIENTIFIC AMERICAN writes on the Paris Automobile Show.

A new type of combined fire and salvage float has been constructed for use on the Manchester Ship Canal. The craft is of great power for both the functions for which it has been designed. For fire-extinguishing work the vessel carries three large monitors, each capable of throwing a solid 2½-inch jet of water to a maximum height of 250 feet at full pressure, and there are also twelve outlets for hose connections, each with main gage instantaneous couplings. The monitors are placed forward, amidships, and aft, respectively, and each is fitted with wheel and worm gear so that the jet can be directed at any angle. A total volume of 3,000 gallons of water can be discharged per minute. For salvage purposes the pumps have a discharging capacity of over 18 tons of water per minute. The speed of the craft is eight knots per hour. The float has been designed more especially for coping with conflagrations among the great warehouses on the banks of the canal, wherein is stored highly inflammable freight.

THE NEW YORK HARBOR ENTRANCE.

BY LEWIS M. HAUPT.

Nearly a score of years has passed since the SCIENTIFIC AMERICAN took a leading part in the popular agitation for deeper channels to this port, when the Chamber of Commerce passed resolutions requesting Congress to authorize the Secretary of War to advertise for a channel 30 feet deep and 500 feet wide, "through that part of the bay at Sandy Hook which experience and judgment indicate as best calculated to be permanently maintained by nature alone, after the first guiding and aiding works have been constructed."

This action was made necessary by the fact that "the largest vessels were obliged to wait for the tides, and the least deviation from the channel insured grounding." Although much progress has been made since that date, and the depths in the bay have been increased from 23 to 30 feet, still the demands of the vessel have far outrun the capacity of the channels, as may be seen from the following exhibit:

Name.	Length.	Beam.	Depth.	Draft.	Displacement.	Speed.	Year.
	Feet.	Feet.	Feet.	Feet.	Tons.	Knots.	
La Bourgogne	492	59	36		18		1898
Paris	560	65	43	26¾	80	19	1899
Campanile	625	65	41¾	25	19,000	22	1903
Oceanic	704	68	49	32½	28,500	20	1899
Baltic	725	75	49	36½	40,000	20	1904 *

* The above statistics are from "The Scientific American Reference Book," just issued by Munn & Co., of New York.

A Cunard Line steamer is under contract to be 790 by 87½ feet, by 60 feet molded depth.

The structural limit for safety, economy, and speed has not yet been reached because of the retarded development in channel and port facilities. Loss of time in port or deficient loading will soon offset the economy of additional capacity of vessel.

To the loaded draft there should be added about four feet for "squat," when running at full speed, and four more for clearance in rough water, making a total of about forty feet necessary to meet modern requirements. It will soon be forty-five at present rate of growth.

The estimate submitted in 1886, for a dike to improve the bar at Gedney's Channel, was so great and the location so objectionable that it was not built, although the board had little confidence in dredging, for it stated: "The Board of Engineers has little expectation that anything more than temporary relief can be obtained by dredging on a bar exposed to the full force of the Atlantic, and hence cannot recommend that method for permanent improvement."

Nevertheless, relief was so urgent that recourse was had to dredging, with the result that in the last annual report (1903) it is said (page 140):

"The estimated cost was $1,400,000 for dredging 4,300,000 cubic yards. The actual amount dredged to October, 1891, when the work was approximately completed, was 4,875,070 cubic yards. . . . The cost of maintenance is estimated at $50,000 annually."

So that in about four years there were removed some 400,000 yards more than the original estimate contemplated, which may have been due to drift. "The amount expended up to July 1, 1903, is $1,939,757.63." The estimates were based on 50 cents a cubic yard for dredging in Gedney's, and 40 cents in the Main Ship channels.

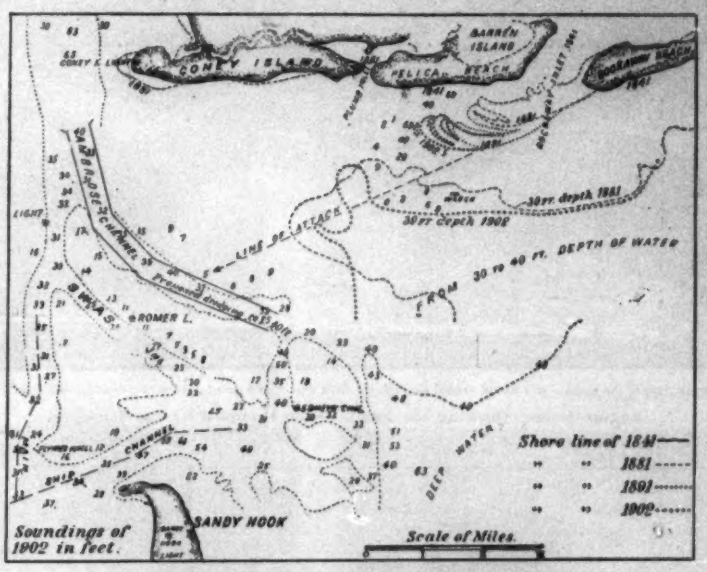
Under *Maintenance*, the report states (page 910): "During the year the 'Gedney' has removed 197,384 cubic yards of material, as follows: From Main Ship Channel, 25,615 cubic yards; from Gedney's Channel, 60,180 cubic yards; from Ambrose Channel, 111,580 cubic yards. The cost of operating the 'Gedney' in Ambrose Channel has been, up to July 1, 14.7 cents per cubic yard of material excavated. The cost for the four months, December to March, was 20.5 cents per yard, and during the months April to June it was 10.7 cents."

So that the expenses of merely operating the dredge were in every instance more than the present contract price paid to private contractors, which is but nine cents, including all fixed charges of deterioration, interest, insurance, dredging beyond limits, for which 17 per cent has been deducted, and incidentals. From the above it would appear to be self-evident that the government work cannot compete with that of private contract, or else the latter is obliged to assume risks which are in fact reckless, to make time, whereas the government may only work in favorable weather and for short hours. The record also states that the "Gedney" could work but 109 days out of the entire year, or only 30 per cent of the daytime. Reducing this to the hour basis at eight hours per diem, it will give but 10 per cent of the year, while the forces of nature are at work all the time in their efforts to re-establish the normal conditions of equilibrium.

To open Gedney's Channel originally required the removal of 350,000 cubic yards, so that if the 60,180 removed represents the accretions of a whole year, it would require only about six years for the channel to be closed. As this shoaling is on the south side, it indicates clearly the source of the drift, and also confirms the correctness of the views of the Board of Engineers as to the temporary character of the work to be expected from dredging.

Under these conditions, and the greater length and shallowness of the Main Ship Channel, an act was finally passed in 1899 providing for the opening of the Ambrose (then known as the East) Channel to a width of 2,000 feet and depth of 40 feet, requiring the removal of 42,500,000 cubic yards at an estimated cost not to exceed $4,000,000, thus necessitating bids at less than 10 cents per yard.

A contract was let for this work May 12, 1899, at nine cents per yard, work to begin July 1, 1901, and payments conditioned upon a rate of excavation of 4,000,000 yards per year, the government reserving the right to augment the plant at any time. The expiration of the contract is not fixed, depending upon appropriations from Congress.



Note advance of Rockaway Beach toward the proposed channel.

PLAN OF NEW YORK HARBOR ENTRANCE.

"Up to July 1, 1903, $704,098.59 has been expended; . . . 8,995,620 cubic yards has been removed. . . . No result useful to navigation will be obtained until the cuts are carried through the outer bar, which is about two miles across." At this rate of progress it will require about ten years to remove the original volume, if the supply of material is intercepted, but it will be seen that the prospect for a greatly augmented deposit in the near future is imminent.

To expedite the progress, the government has built two dredges estimated to cost $700,000 to construct, and $185,000 to maintain and operate.

The first of these dredges has recently gone into commission in competition with the contractor's plant on the bar. With a smaller vessel, shorter hours, and larger crew, it should furnish some conclusive data as to the relative efficiency of the two methods of conducting works.

THE MENACE TO THE PORT.

It is well known that this entrance bar is the natural depository of the littoral drift from the shores of Long Island and New Jersey, and that a mere local, mechanical removal thereof will not permanently improve the channels, so that the question of the amount of this drift is of primary importance. This involves a comparative study of the rate of progress of the great deposits which encircle the inlets, especially of the south shore of Long Island, but space does not permit of details.

The charts show that Fire Island Inlet has drifted to the west at the average rate of 200 feet per annum. Rockaway Inlet has traveled west as well as south, at the rate of three miles in sixty years, or nearly 260 feet per annum, and it is fast encroaching on the entrance, which it will seriously throttle in its mailed hand, so suggestive in the plans. These progressive movements are best seen in the cut showing the erosion of Pelican Beach, the overlapping of the former coast line and the shoaling of the former great depths. A wreck in 3 feet of water now marks a former depth of 37 feet, and channels of 40 feet depths are now fast land. The shoaler water, as this bank approaches the bar, will expedite its progress, while its line of action, produced, will cut the proposed channel in twain. The question is one requiring immediate and serious consideration, and it is not one which can be met by an attempt to compete with natural forces by dredging. This movement should be arrested before it has gone further, since the natural dumping ground for the littoral drift, which was Jamaica Bay, is now closed to it.

Before the 40-foot channel can be opened this menace will be much greater, and it would seem to be the part of wisdom to give serious consideration to the possibility of opening and maintaining the channel by "nature alone," assisted by suitably located training-walls, which will not obstruct any of the channels nor interfere with the tidal ingress in the least, and which can be built at less than one-half the cost and time of this temporary expedient, if estimated at profitable prices.

Forestry and the Railroads.

Upon the advice of the Bureau of Forestry the Gulf, Colorado and Santa Fé Railroad eight months ago began to experiment with wooden tie-plates. These plates are intended to protect the tie from wear under the rail. They are cut the width of the bottom of the rail and as long as the tie is wide—usually 6 or 7 inches—and are kept in place by the weight of the rail, in a flat groove in the tie. The results of the experiment are of much interest both to the railroads of the country and to those who have at heart the cause of forest protection.

The Santa Fé placed cypress tie-plates one-quarter of an inch thick on several thousand old and much-worn cypress ties laid in its track north of Galveston, Tex. After eight months of constant use the plates are perfectly sound and show practically not a trace of wear. The officials of the road are greatly pleased with the result of this trial.

The Bureau of Forestry will now make similar experiments with red gum, red oak, and beech tie-plates, which will be placed in the tracks of the St. Louis and San Francisco, the Burlington, and the Northern Pacific systems. These are all harder woods than cypress, and are therefore less liable to wear under the rails, but are much more subject to decay. The tie-plates made from these woods will therefore all be heavily creosoted. This will make them about as resistant to decay as the untreated cypress, while their much greater hardness will better qualify them to resist the wear of the rails.

For a number of years cross-ties have been treated with preservatives, and tie-plates of iron have been used to increase their length of service. Tests are constantly being made by the Bureau of Forestry to improve the character of the preservatives and the methods of their application, and to enlarge the number of woods used for railroad construction purposes. Experimenting with wooden tie-plates is work along the same economical line, in the interest of both the railroads and the forests. The use of a tie-plate prevents wear on the tie and adds years to its service; wooden tie-plates are being successfully substituted for the more expensive iron; and abundant and cheaper woods, through preservative treatment, are becoming available to take the place of scarce and expensive woods. When a wooden tie-plate is worn out a new one can be quickly and cheaply inserted in its place. In Europe these plates cost but $2 a thousand, or $2 for every 500 ties, since two are used upon each tie. Preservative treatment keeps the tie from decaying, the wooden tie-plate keeps it from wearing, and the use of both will result in a huge economy for the railroads, which will react favorably upon our forests.

M. Laubeuf, the chief naval architect of the French Admiralty, and designer of the "Narval," the most successful of the French submarines, has devised a new type of submarine of greater speed and capable of more rapid submersion than those at present in commission. The new vessel resembles in general appearance the former boats, but is fitted with special mechanism which enables it to be completely submerged within two minutes, as compared with seven or eight minutes occupied by the old models. The craft is propelled by motors developing 250 horsepower with a speed of 16 knots.

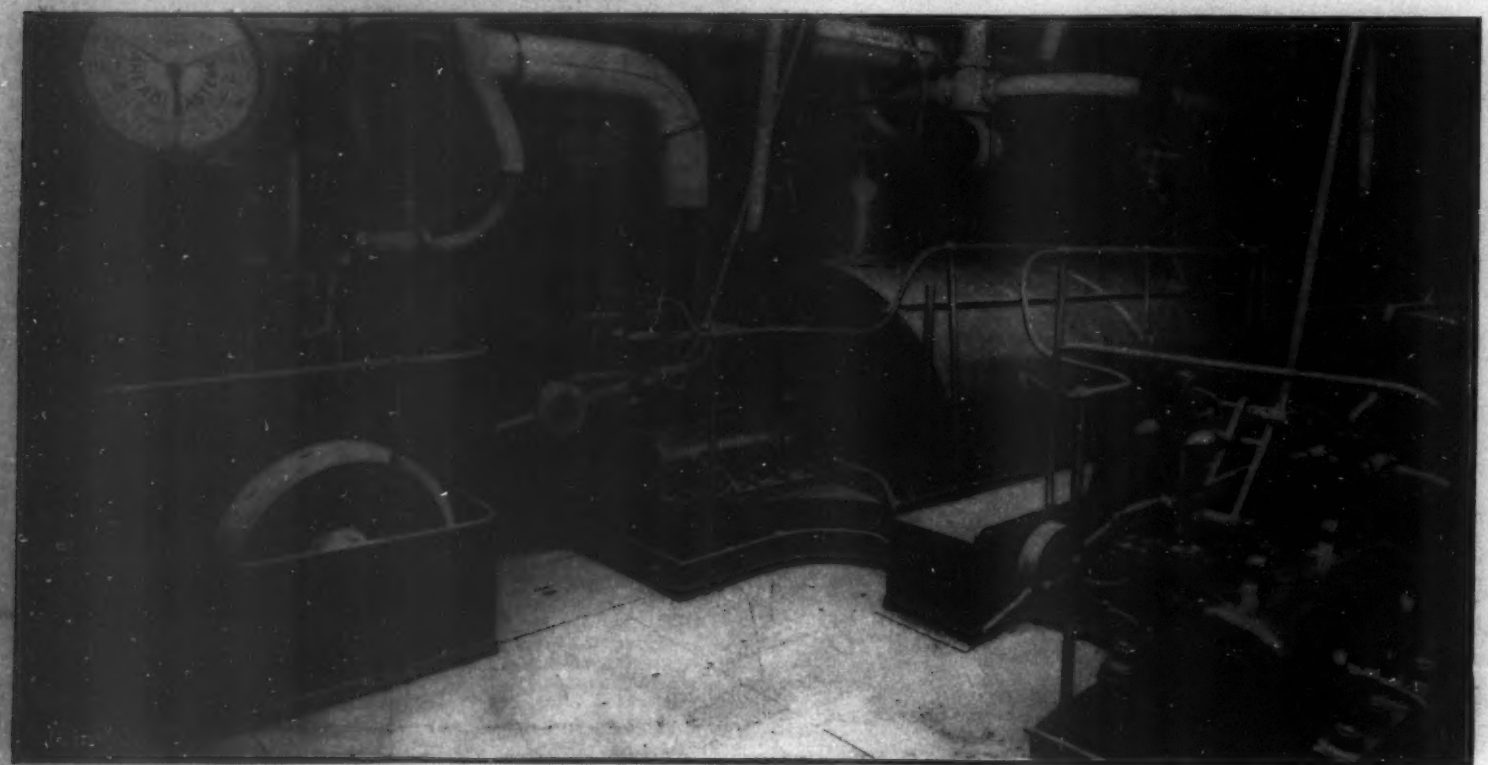
THE TURBINE-DRIVEN STEAMER "MANXMAN."

BY EMILE G. JARISE.

The turbine-driven steamer "Manxman," lately built at Barrow-in-Furness by Messrs. Vickers, Sons & Maxim, Ltd., for the Midland Railway Company's Isle of Man service, comprises three sets of expansion turbines, the center shafts being driven by the high-pressure turbine, and each of the two side shafts by a low-pressure turbine, the astern-driving turbines being mounted also on the side shafts. These latter take steam direct from the boiler.

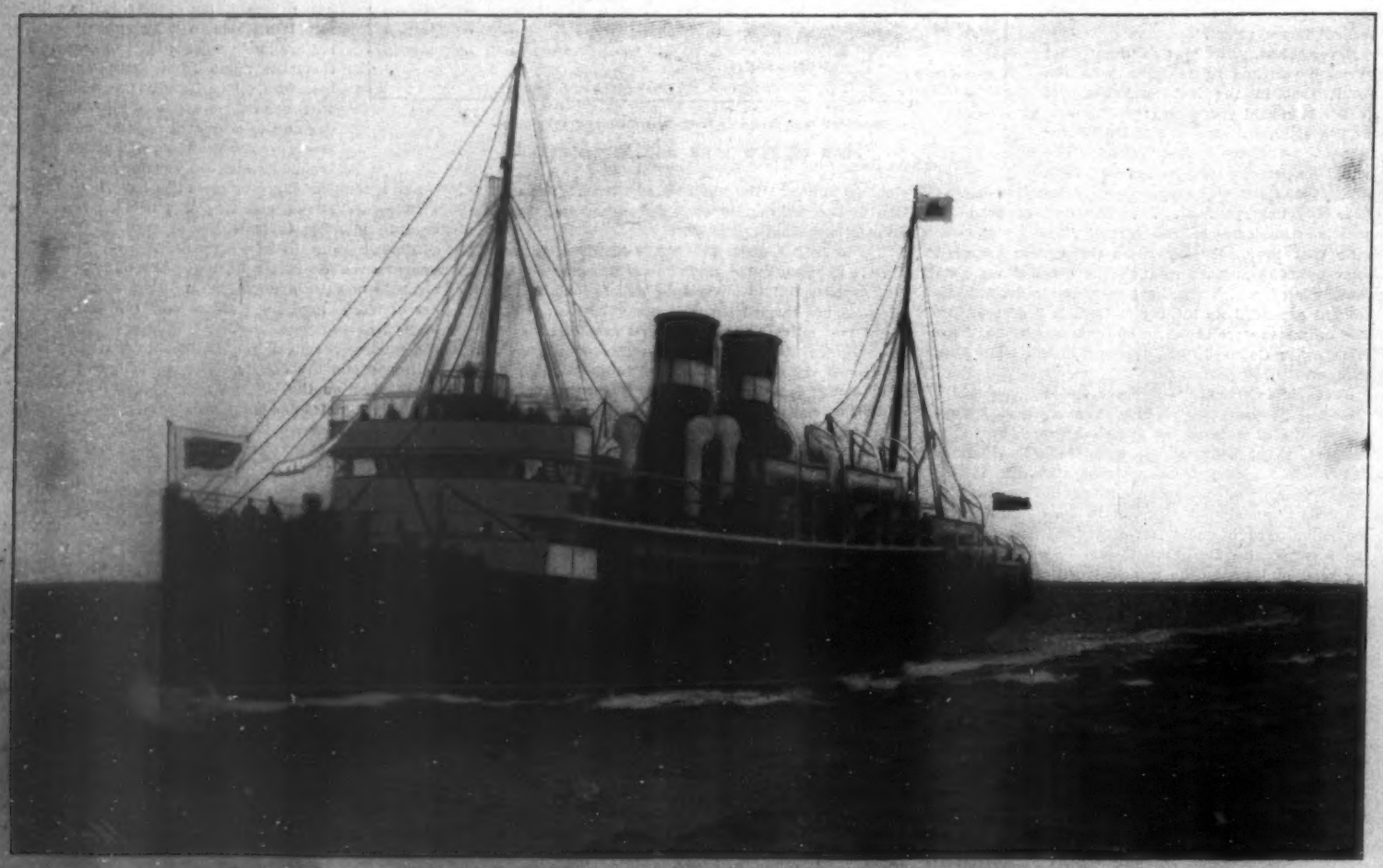
In respect of speed, the "Manxman" is three-quarters of a knot faster than the "Londonderry," another Midland vessel with smaller turbines taking steam at 150 pounds pressure. Two trials were made over the measured mile, and the results were the following: mean speed of two runs, 22.141 knots; boiler pressure per square inch, 192 pounds; steam in high-pressure turbine, 180 pounds; in low-pressure turbine, port, 20 pounds; steam in low-pressure turbine, starboard, 20 pounds; vacuum in condenser, port, 28.25 inches; vacuum in condenser, starboard, 28.4 inches; revolutions per minute, high-pressure turbine, 533; low-pressure turbine, 609; temperature of feed water leaving heater, 180 deg. F.; air pressure in stokehold, 1.5 inch. The results for the official six hours' trial were as follows: mean speed, 22.60 knots; revolutions, high-pressure turbine, 526; low-pressure turbine, 590; vacuum, port, 28.6 inches; vacuum, starboard, 28.4. The vacuum was frequently as high as 29 inches. In this respect a great improvement has been effected by the use of a "vacuum augmenter." In it the air pumps are placed about three feet below the bottom of the condenser. From any convenient part of the condenser, preferably near the bottom, a pipe is led to an auxiliary condenser, generally about one-twentieth the cooling surface of the main condenser, and in a contracted portion of this pipe a small steam jet is placed, which acts in the same way as a steam exhauster or the jet in the funnel of a locomotive, and sucks nearly all the residual air and vapor from the condenser, and delivers it to the air pumps. A water seal is provided to prevent the air and vapor returning to the condenser. The small quantity of steam from this steam jet, which is only about 1½ per cent of that used by the turbine at full load, together with the air extracted, is cooled and condensed by the auxiliary condenser, which is generally supplied with water in parallel with the main condenser. Condensation in a condenser takes place much more

(*Continued on page 10.*)



Vertical reciprocating engines of the same power would extend through the deck above, and occupy space that is now available for passenger accommodations.

Engine Room, Showing the Small Space Occupied by the Turbines.



THE NEW TURBINE STEAMER "MANXMAN" MAKING HER TRIAL SPEED OF 22.6 KNOTS AN HOUR.

THE PRUNE AND ITS CULTIVATION.

BY ERCE BROWN.

The consumption of prunes in the United States exceeds 100,000,000 pounds yearly. Prior to 1886 the supply came almost wholly from France and the Danubian provinces, and sold under the designation of "French" or "Turkish" prunes.

In the year referred to, prunes of American growth appeared on the market, and with each succeeding year the supply has increased, until the importation of foreign fruit has been reduced to extremely small proportions.

Much the larger portion of the prune supply is the production of California, where climatic peculiarities are extremely favorable for its production.

In Santa Clara County alone there are 3,700,000 trees growing on 37,000 acres, 100 to the acre, yielding 330,000,000 pounds, or thereabout, of green fruit, or 80 pounds from each full-grown tree. The quantity of prunes somewhat exceeds 110,000,000 pounds—more than enough for the requirements of the whole country, but the excess, with that raised in other localities, is needed to supply the export demand from Great Britain, Germany, and France.

The first plum trees planted forty years ago in

Ten Thousand Trays of Prunes.

Irrigating a Prune Orchard.

Grading the Green Fruit.

Facing and Fixing Prunes.

A View in the Prune Warehouse.

A Prune Orchard in California.

Budding Trees in Nursery.

THE PRUNE AND ITS CULTIVATION.

California were shoots from the "Pettite" and "Epineuse" varieties from France. These original varieties have been greatly improved upon.

In preparing the ground for planting, repeated plowings and harrowings are required thoroughly to pulverise the soil and destroy surface vegetation. Year-old seedlings are planted in holes, round or square, about two feet in dimensions each way. After planting, which is done in the rainy season, the shoots are cut down to a uniform height of about two feet. The orchard is cultivated several times during the first year. In the second year the trees are pruned, from three to five branches being left, and are again pruned in the third and fourth years. Some orchardists prune every year, no matter what the age of the tree may be. The soil is repeatedly cultivated in all orchards.

Twice during the spring and summer the orchard is irrigated, water being procured from wells of moderate depth. In September the fruit ripens, and is gathered by spreading sheets under the tree and shaking the branches. The green fruit is then taken to the warehouse, where it is graded to size and afterward passed through a boiling-hot liquid, in which process it is cleaned and the outer skin softened. It is then spread out in trays 8 by 3 feet in size, and exposed to the heat of the sun for three to eight days, depending upon weather conditions.

Ten thousand trays of fruit spread out in one unbroken tract may be seen in Santa Clara in the drying season. When sufficiently cured the prunes are stored in separate bins and there allowed to "sweat," this process taking from ten to twenty days, when they are ready for marketing. Ten different grades are required, ranging from an average of 35 to the pound to the smallest size, averaging 140.

The cured fruit is packed in boxes, sacks, or barrels. Many buyers for the domestic or foreign market buy in gross, and afterward repack in smaller boxes.

Large quantities are thus attractively packed in Santa Clara, and many women are employed in this work, which requires special care and deft fingers. Boxes of the proper size with one glass face are used. Lace paper and ornamental labels add to the handsome appearance of the package. Carefully selected and perfect fruit is flattened by the hands, and spread out on the glass to form the exposed layer. The box is then filled to the required weight by fruit of corresponding grade. In fancy packing the French only can equal the Santa Clara standards.

The prune is the source of the remarkable prosperity which the community enjoys. The city of San José is the prune metropolis of the world, as nowhere else is this fruit handled in such amount or by equally scientific methods. The climate is mild, and the floral growth is amazingly luxuriant and beautiful. Of the thirty thousand inhabitants of this beautiful city, there is not one but is dependent upon the staple crop for much of the prosperity enjoyed.

THE TURBINE-DRIVEN STEAMER "MANXMAN."

(*Continued from page 8.*)

rapidly and effectually if the air is thoroughly extracted than if there is much air present, as the air seems to form a blanket round the tubes, and prevents the steam from getting free access to them.

The turbine machinery was constructed by the Parsons Marine Turbine Company, Wallsend-on-Tyne. There are two double-ended boilers and one single-ended boiler, and the principal dimensions of these are, for the double-ended boilers: length, 22 feet; diameter, 15 feet 7 inches; number of furnaces, six; diameter, 3 feet 11 inches; length of grate, 6 feet 6 inches; heating surface, 4,984 square feet; grate area, 161 square feet. For the single-ended boiler: length, 11 feet 6 inches; diameter, 15 feet 7 inches; number of furnaces, three; diameter, 3 feet 11 inches; length of grate, 6 feet 6 inches; heating surface, 2,493 square feet; grate area, 80 square feet. The total heating surface is 12,461 square feet, and the total grate area 402 square feet. The two double-ended boilers are placed side by side in the after part of the boiler room, while the single-ended boiler is fitted in a recess in the center of the boiler room forward, with large coal bunkers on each side. The boilers are worked under forced draft, the stokeholds being closed, and four fans are located on the upper deck, and are driven by high-speed engines, supplied by Messrs. Gaul & Co., Dumbarton.

For the Isle of Man traffic, the principal requirements are extensive promenade spaces and large saloons, and these are a special feature of the new vessel. The "Manxman" has a length on the waterline of 330 feet, a breadth, molded, of 43 feet, and a depth of 25 feet 6 inches. She has four decks, one of these—the shade deck—being entirely devoted to a promenade, while the promenade deck has a considerable width on each side for the same purpose.

The dining saloon occupies the full width of the ship, and has seating accommodation for one hundred passengers. The saloon is situated at the forward end of the promenade deck, and occupies, with the smoking room, a deckhouse which extends for over 130 feet of the length of the ship. With its lounges, etc., it will form a very welcome retreat in rough weather on the Irish Sea. On the deck below there are arranged the principal sleeping rooms in the ship. Many of these cabins have been made portable.

The heating and ventilation are by the thermotank system of the Thermotank Ventilating Company, of Glasgow. This system aims especially at insuring to all the living quarters of the ship a continuous supply of fresh air, which is not only warmed to the requisite degree, but is also humidified, so that none of the bad effects of overdrying can be felt. In cold weather the warmed air is discharged through a regulator into each apartment near the level of the ceiling; as it cools, it gradually sinks to a lower level, carrying with it any carbonic acid gas to the passageways, where means are provided for allowing it to pass outside. The circular thermo-tanks for circulating the warm air are placed on deck. The thermo-tank consists of an electric motor operating a fan which discharges air to the outside of a tube heater. The air then passes through the tubes, and comes in close contact with the heater surface, flowing thence to the main distributing trunks. Tests have shown that where the steam-heated system took three hours to attain a given temperature, the thermo-tank only required fifteen minutes.

THE LARGEST LOBSTER ON RECORD.

In our issue of May 17, 1902, we published an illustrated description of the largest lobster which up to that period had been caught. This giant crustacean is 3 feet long, weighs 34 pounds, and is preserved in the collection of the American Museum of Natural History. Since the writing of this article another lobster has been caught much larger in size. The new crustacean is 45 inches long, weighs 36 pounds, and is large enough to encircle a man with his two large claws. The accompanying illustration gives one an excellent idea of the size of the creature.

THE LARGEST LOBSTER EVER CAUGHT.
Length, 45 inches; weight, 36 pounds.

Another Successful Flight of the Baldwin Airship.

One of the most remarkable flights which the Baldwin airship has yet made took place at Los Angeles, Cal., on December 25.

The "Arrow" started from Chutes Park baseball grounds, in the southeastern part of the city, at 3:17 P. M., sailed with the wind northeastward between eight and ten miles, thence eastward for two miles, and returned in the face of a twelve mile gale to a point directly above the starting place. The supply of gasoline ran short, and Knabenshue, the aeronaut, was unable to effect a landing at exactly the desired spot. From the time the airship arose from the baseball grounds until it was safely anchored at Pico and Stanford Streets, it was in flight an hour and thirteen minutes, and in that time sailed a distance of probably twenty miles. When flying with the wind the "Arrow" traveled at a speed of twenty miles an hour, and returning directly in the face of the strong southeastern gale, was able to make a rate of speed reckoned at between six and eight miles an hour.

The French Admiralty has sanctioned the construction of the light type of submarine boats which are to be utilized strictly for defensive purposes. These vessels, will each weigh 44 tons and are essentially of small range and power. Ten of these craft are to be built, six being constructed at Cherbourg and four at Rochefort. They are to be known as "wasps" and will be numbered from 1 to 10 consecutively.

Automobile Notes.

At the Crystal Palace a series of experiments were made by Mr. S. F. Edge to prove that damage to tires is not a common cause of motor-car accidents. The experiments were carried out on a specially-prepared road, on which broken bottles, chisels, and spikes were laid down, and over these a touring car and the car which Mr. Edge used in the German Gordon Bennett contest were driven at a speed of between 40 and 50 miles an hour. The first result was the discovery that the puncturing of a tire is no easy matter. The touring car went over the spikes, chisels, and broken glass about a dozen times before a puncture was made, but so little effect had the accident upon the car that the occupants did not know what had happened till they pulled up. The trials with the racing car were more exciting. A puncture was made early, and the tire became deflated. Mr. Edge, however, paid no attention to this, and rode on, but nothing untoward occurred. The deflated tire was next loosened at one side with the object of running it off while the car was going at full speed. The tire when thrown off whirled to a considerable distance, but the car kept its course, and neither it nor its owner was one whit the worse. These trials go to show that, provided the car is properly designed and of reasonably good workmanship, damage to tires will not endanger the occupants.

Several routes have been proposed for next year's Bennett Cup race, which is to be run in France. The Eure and Loire Department recently submitted a project to the Automobile Club for the eliminating trials and the cup race. It proposes a circuit situated in that region and lying mainly in the flat plain of the Beauce, where an excellent ground can be obtained. The circuit will run from Chartres to Nogent (33 miles), thence to Chateaudun (31 miles) and return to Chartres (26 miles), with three grade-crossings and three neutralizations in the course. Another route is proposed by the mayor of Clermont-Ferrand. It has a number of points in its favor. This circuit lies in the Auvergne region, one of the most agreeable and picturesque in the country. It forms a loop having a total length of 80 miles, starting from Clermont-Ferrand, taking in a number of villages. One advantage of this circuit is that all the roads which will be passed over are national routes and in good condition, having 45 feet width between ditches for the most part. The route, without being dangerous for high speeds, has a series of long and steep grades which will afford a good test for the cars. In this case no part of the road will need to be neutralized, seeing that it passes the villages, which are insignificant, at its full width, and is not narrowed anywhere. This is an advantage both regarding high speeds and absence of danger. The Automobile Club will no doubt decide upon the best circuit for the cup race before long.

It is proposed to organize a series of competitive tests for electric automobiles in Paris, with especial reference to electric cabs, in order to stimulate the interest in this class of vehicle and show the progress which it has made within recent years. The first contest of electric cabs, which was held in 1898, did a great deal toward promoting the interests of electric cars. It seems to be the general impression in France that the electric automobile is very expensive and cannot keep up a hard service in a regular way. But in the present state of the question this can be easily shown to be untrue, and it can be proved that it is cheaper than the horse vehicle for city use. It is stated that it costs only half as much as the horse coupé and besides can stand a daily service of 30 to 40 miles, which the former cannot accomplish. The former objections to accumulators, their fragility, small capacity, and heavy weight, can no longer be urged, seeing that there are now in Europe nearly a dozen types of battery which are solid and light. If the actual facts can be brought before the large cab companies there is no doubt that they would seriously consider the question of replacing horses by electric cabs. The experiment was tried a few years ago, but with a type of electric coupé established on the old lines, and it did not succeed. But there is no reason why it should not do so at present, in view of the recent progress which has been made. America is taking the lead in the matter of electric automobiles, but this is to be attributed to the widespread use of this type of machine rather than to any superiority of manufacture, and it is hoped to secure a like success in France, if the question is properly promoted. There are a number of first-class cars now manufactured in or near Paris, such as the Krieger, Vedrine, Jeantaud, Gallia, Electromotion, Mildé, and others. A concourse of electric cars therefore seems to be in order, and it will bring out an interesting series of official data as to the modern electromobile, especially as regards electric cabs.

THE QUEEREST OF CREATURES.—I.

BY J. CARTER BEARD.

The merely casual visitor to the New York Zoological Park hardly finds much entertainment in watching the lemurs as they lie sound asleep all day long distributed about the ample inclosure allotted to them. But as daylight fades, as the last visitor leaves the building devoted to the Primates, and all the baboons, and the red-faced Japanese monkey, and the green monkeys, and the prehensile-tailed American apes lie fast asleep, the fun in the lemur cage begins. Such kangaroo-like hopping about and leaping from perch to perch, such odd gestures, eccentric gaits, and queer attitudes, and such wide and lofty tumbling surely are never seen elsewhere. Though there are only the nocturnal new world monkeys to watch and applaud, if not to emulate, their feats, the lemurs carry on a regular circus until the dawn of another day sends them back to their slumbers again.

The sole exception to this state of affairs is perhaps that of the common ring-tailed or cat lemur (*Lemur catta*) which at any time of day is quite ready to be fed or noticed, and which goes to bed with monkeydom in general. The ring-tailed lemur is an exception to the rest of his tribe, not only in keeping awake during the day, but in belonging to a species that lives upon the surface of the ground, among rocks, instead of passing an entire lifetime in the tree-tops.

The great tropical woodlands, wide as the torrid zone, shelter strange creatures, which, in addition to their extraordinary appearance and habits, exhibit puzzling structural similitudes to others belonging to different orders and even to a different class. In some cases, these similar creatures live upon opposite sides of the globe. The name Phosimii applied to the lemurs and to lemur-like mammals, as well as the German name Halbaffen (half apes) indicates the position of the Lemuridæ at the foot of the Primates, and also the fact that they are half apes only, the other half being peculiar to the species and different from all other mammals, or showing apparent affinities to alien groups of animals, sometimes much lower than themselves. There are, for instance, among the lemurs, species in which the different parts of the hands and the feet are so divided as to form two lobes, resembling in shape and in function those of the chameleon. The lemurs thus distinguished creep very slowly toward their prey, taking a secure hold of a supporting limb or branch with one hand, or with one foot, before bringing forward another, just as does the chameleon. The round, protruding eyes and the slow mechanical movements of the mammal remind one of the queer lizard mentioned, while the insect-feeding habits of both are identical, except, indeed, that the chameleon hunts by day and the lemur by night. The latter even possesses a second auxiliary tongue, which can have no other purpose than to aid the creature in catching flies, just as the development of such a member assists the insect-catching lizard.

A very curious formation, consisting of an arrangement of the blood vessels, called by recent physiologists "the wonderful network" (*rete mirabile*) belongs to all species of slow lemurs. The limbs of animals having this peculiarity, instead of being supplied with arteries and with veins with long branches, as is the case with mammals generally, are furnished with two series of blood vessels lying closely parallel to each other, one series being of hair-like tenuity and the other somewhat larger, joined to the first by short, tubular projections. Such an arrangement of the circulatory system occurs in the legs and the arms of the animals under consideration and nowhere else except, strange to say, quite on the other side of the world, in the sloths of South America. To animals possessing it, this *rete* gives great muscular power in executing very deliberate, gradual, almost imperceptible motion continued for a long time.

Like the bats among the mammals, and the blue crowned parakeet among the birds, the lemurid possessing a *rete mirabile*, or plexus, as it is sometimes called, reposes and sleeps hanging from a bough, head downward. An automatic arrangement of the flexor muscles above the knee, analogous to that which adapts the claws of birds to retain their grasp upon a limb, or the bats to hang suspended from a bough, enables these animals to do this. The *rete mirabile* assists in making this, their favorite position, the one in which they can secure the most perfect repose.

The lemurids thus constituted are called the slow lemurs, and well deserve the name. It is possible that they are the slowest of mammals. The fact may be stated, in order to allow the reader to appreciate properly the extreme slowness of these animals, that one of them, not belonging to the slowest species of the group, when timed, took exactly thirty-two minutes and three seconds in moving across a space of four feet toward a roach that it was endeavoring to capture.

The particular animal referred to was a slow-paced loris (*Nycticibus tardigradus*) belonging to an Asiatic genus that has quite a considerable range, extending as it does from Java, and Sumatra, and Borneo, and quite possibly some of the Philippine Islands, through parts of Hindostan. When its progress was timed, it advanced "within ten or twelve inches of its quarry, rested upon its hands, drew its hind feet gradually forward until almost under its breast, very slowly and cautiously raised itself upright into a standing position, balancing awkwardly with uplifted arms, and then threw itself bodily—not upon the insect, which was off and away like an arrow from a Tartar's bow, but upon the spot the roach had occupied half a second before."

If its rations did not largely consist of vegetation, leaves, tender shoots, and fruits, it might be somewhat difficult to understand how, with the method described, which is without doubt its habitual manner of capturing its supply of animal food, it could possibly escape starvation. Fortunately for Tardigradus, caterpillars, larvæ of various kinds, quiescent moths, as well as birds' eggs and young birds, exist in sufficient numbers in the trees where he takes up his quarters, to enable him to vary his vegetable diet.

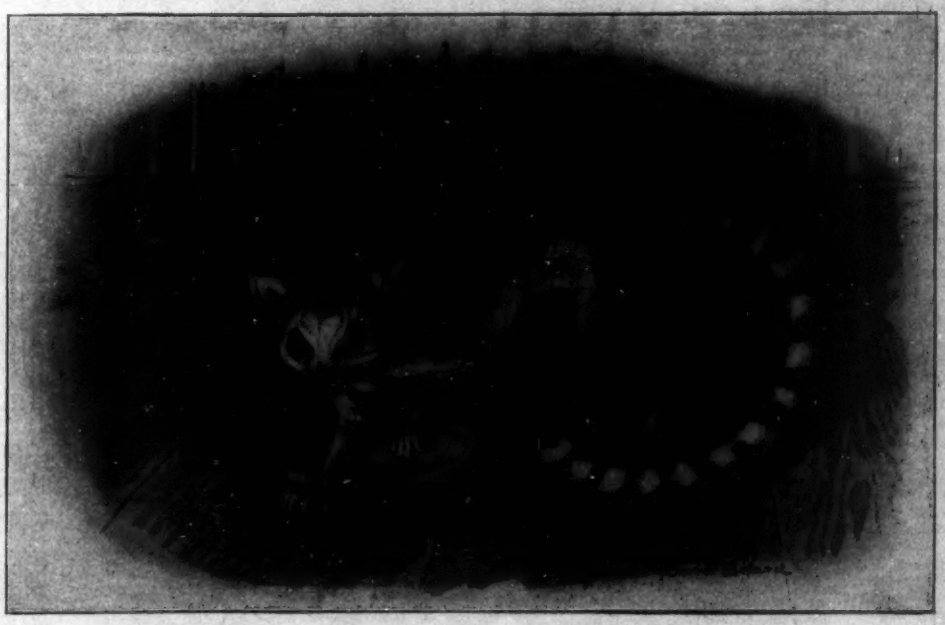
The adaptive parallelism between these animals and the sloths is by no means limited to the arrangement of the blood vessels in the limbs and the consequent slowness of their movements. Their postures, when asleep, their exclusively arboreal life, their excessive awkwardness, and almost entire helplessness upon the ground, and the abortion of the tail and of certain of the digits upon the hands and the feet, as well as the exceptional form of the placenta, which is shared by no other kinds of mammals, are all links uniting the families of the Bradypodidæ and the Lemuroidæ.

The nocturnal habits of lemurs are shared, of course, not only by the sloths, but by a great number of other animals; but the peculiarity of adaptation to nocturnal vision in the eye of a lemur more particularly resembles that in the cat and the owl. As is the case with the owls and the cats, the membrane around the pupil of the eyes enlarges or contracts automatically, making the "black spot," the pupil of the eye, larger or smaller in proportion to the light to be admitted. The pupil may be called the window of the eye, and the iris, the membrane around it, the curtains that shade the eye.

In sunlight these curtains are almost wholly closed, shutting out the superfluous and injurious glare; but in the evening they are drawn aside to admit all the light possible, thus contracting the part of the pupil visible until it appears a mere slit, or enlarging it until it occupies the whole or nearly the whole of the eye-space. But besides this, there is what is called the tapetum, an area in the colored coat of the eye which acts as a concave reflector, collecting and making the most of the faintest glimmer of light, so that at times the eyes of animals possessing it glow in the dark with what appears a phosphorescent luster. In addition to all this, there is in the slow lemur an arrangement of unequally developed fibers encircling the lids, which cause them to close obliquely outward and inward instead of shutting down from above in the usual way. This gives the slow lemur the very strange, uncanny expression peculiar to the creature when seen by daylight.

THE SLOW LORIS (*Nycticibus tardigradus.*)

This is said to be the slowest-moving animal in existence.



RING-TAILED LEMUR (*Lemur catta*).

Unlike most lemurs this variety hunts during the daytime and lives among rocks and caves instead of upon treetops.

(*To be continued.*)

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

STATIC ELECTRIC MACHINE.—J. G. H. Bunsos, Chihuahua, Mexico. In this patent the invention has reference to means for generating static electricity, and more particularly to the production of a simple, compact, efficient, and reliable form of machine of the so-called "induction" type. The action of the machine is continuous and the machine is double-acting.

PARTY-LINE TELEPHONE SYSTEM.—W. Parker, Leicester, N. Y. This party-line telephone system is so arranged that a subscriber, by pressing a button, cuts the line in two and produces a comparatively short metallic circuit of low resistance. Each station is provided with a revolubie commutator actuated by the weight of the receiver so that the simple act of hanging up the receiver cuts the resistance of the station out of the talking circuit, but leaves it in the calling circuit.

Of Interest to Farmers.

FLOOD-FENCE.—J. Elliott, Martinsville, Ill. In this instance the invention relates to an improvement in flood-fences or water-gates which are used for closing gaps in a line of fence where it crosses streams of water or on very low lands. It may also be used as a cattle-guard to prevent the cattle from straying from a pasture where a stream of water passes through such pasture.

BEET-TOPPING MACHINE.—W. D. Buchtel, Sr., and W. D. Buchtel, Jr., Brady, Neb. This improvement relates to a beet-topping machine, and more particularly to that class adapted for topping beets while they are in the ground. The object is to provide a machine for topping beets and to construct the same in such manner that it may be propelled by horse or other power and operated with the greatest ease.

Of General Interest.

ORE-LEACHING APPARATUS.—W. S. Jones, Greensburg, Pa. This invention is an improvement in the apparatus for use in leaching ores and for similar operations, and is especially applicable to the cyanid process of extracting gold or silver, although the invention will be found useful in other leaching processes, and is particularly advantageous in agitating slimes, i. e., the very fine part of ore obtained in crushing.

STOVEPIPE-CLEANER.—W. J. Yeoman, Mankato, Kan. The aim of the inventor is to furnish a means or device for cleaning stovepipes and chimney-flues, so constructed that it is adapted to be conveniently inserted in and removed from the pipe or flue. The chief feature is a scraper consisting of a metal blade, which is so attached to a handle that it may be adjusted in the same plane therewith, or at right angles thereto, as required for inserting it in the stovepipe and for effective work therein.

BABY-JUMPER.—Jane A. Morehouse, Newark, N. J. The purpose of the improvement is to provide a spring-supported rest or seat so constructed and suspended that a saddle is formed beneath an opening in the frame, which saddle is connected with the frame at front and rear of the opening and is fitted with an upholstered seat shaped to afford perfect freedom to the lower limbs when seated and to so sustain the frame from an overhead support that a spring-controlled action will be obtained in vertical direction while the frame is free to swing laterally.

Household Utilities.

CLOTHES-RACK.—N. M. Coyner, Frankfort, Ohio. Mr. Coyner's improvement is in that class of racks having a series of hinged or pivoted arms adapted to be extended horizontally and radially or folded in vertical position parallel to each other when not required for use. He has combined a series of such hinged arms with a box adapted to contain them when not in use, the swinging cover or door of the box being adapted to support the arms horizontally in position for use.

Machines and Mechanical Devices.

SUCTION DEVICE FOR PULP-MACHINES.—J. L. Youngs, Chateaugay, N. Y. More especially this invention has reference to the class of suction devices or apparatus employed in the manufacture of paper and other pulp for the purpose of eliminating or withdrawing therefrom as much as possible the moisture contained therein (previous to the delivery of the pulp to the driers or presses therefor), and is intended as an improvement upon the device set forth in former Letters Patent granted to Mr. Youngs.

MACHINE FOR MOISTENING, LAYING, AND BINDING GUMMED PAPER.—Beatrice Simpson, New York, N. Y. The object is in this case to provide a hand-machine more especially designed for binding the edges of lantern-slides, picture-frames, and other passe-partout articles with a gummed strip of paper, leather, or other flexible material, the machine being arranged to pass the gummed flexible strip over a moistening device to moisten the gummed face of the strip, to pay out the latter, and to press a portion thereof directly onto the edge of the article to be bound by the flexible strip.

Railways and Their Accessories.

BLOCK-SIGNAL SYSTEM.—T. Silvene, Victoria, British Columbia, Canada. Among the several objects of this invention are the following: first, to enable trains upon the same track to warn each other with greater certainty; second, to render the action of the semaphore-arms more efficient; third, to enable the engineer of each train to know whether certain signals are made by his own or by another train, and, fourth, to make certain improvements in the contact mechanism and connection. The invention embodies certain improvements upon Mr. Silvene's former patent for an electric block-signal system, and has features that are very advantageous, as for examples, if an engineer fails to heed a warning presented, the brakes are automatically applied. No false alarms can be given. Signals are ascertained at a glance.

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Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 6362.—Wanted, a strip of sheet metal about 8 inches wide, 4 feet long, covered with sharp, needle-like points about ¼ inch long and 1-16 inch apart.

Autos.—Duryea Power Co., Reading, Pa.

Inquiry No. 6363.—For manufacturers of an automatic funnel.

For logging engines. J. S. Mundy, Newark, N. J.

Inquiry No. 6364.—For manufacturers of hot water heating apparatus, for building 35 x 75 feet, four stories high.

"C. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 6365.—For manufacturers of electric motors and 10 to 20 h. p. machines for grinding corn, etc.

Perforated Metals. Harrington & King Perforating Co., Chicago.

Inquiry No. 6366.—For the best and latest improved diamond drills.

Handle & Spoke Mchy. Ober Mfg. Co., 29 Ball St., Chagrin Falls, O.

Inquiry No. 6367.—For estimates of cost of hydraulic turbine wheel complete with bevel gear and 12 feet of horizontal shaft, delivered at Liverpool.

Adding, multiplying and dividing machine, all in one. Felt & Tarrant Mfg. Co., Chicago.

Inquiry No. 6368.—For a welding machine to weld steel bars from 1-inch to 2-inch material to be tool steel as a rule.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 12, Montpelier, Vt.

Inquiry No. 6369.—For makers of the Poulsen telegraphone.

Robert W. Hunt & Co. bureau of consultation, chemical and physical tests and inspection. The Rookery, Chicago.

Inquiry No. 6370.—For makers of centrifugal tinning equipments, or tinning outfit by centrifugal method.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of East 138th Street, New York.

Inquiry No. 6371.—For a combination dynamo and gasoline engine for an electric plant.

I have every facility for manufacturing and marketing hardware and housefurnishing specialties. Wm. McDonald, 109 Main St., East Rochester, N. Y.

Inquiry No. 6372.—For makers of machines for disbarring banana plant.

The Scientific American Supplement is publishing a practical series of illustrated articles on experimental electro-chemistry by N. Monroe Hopkins.

Inquiry No. 6373.—For manufacturers and jobbers of novelties, such as disc and novelties.

Sheet metal, any kind, cut, formed any shape. Die making, wire forming, embossing, lettering, stamping, punching. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 6374.—For parties to manufacture a bag about size of 3-gallon water bag, strong enough to resist about 125 pounds intern.l pressure.

We manufacture gasoline motor and high-grade machinery, castings best quality gray iron. Select patterns, and let us quote prices. Frontier Iron Works Buffalo, N. Y.

Inquiry No. 6375.—For makers of medicinal tablet machines, also of small paper boxes.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadrigs Manufacturing Company, 16 South Canal Street, Chicago.

Inquiry No. 6376.—For makers of wood alcohol and acetic acid plants, also paint machinery and felt for manufacture of ready roofing.

The Clyde Salvage Company, Limited, 40 St. Enoch Square, Glasgow, desires to get into communication with merchants requiring shipments of scrap iron, chain cable, old horse shoes, anchors and general hard goods, new and old. References: The Union Bank of Scotland, Limited, Scotland.

Inquiry No. 6377.—For manufacturers of voting machines.

Patents sold. No advance fee charged inventors. S. H. Human & Co., 371 Washington St., Chicago, Ill.

Inquiry No. 6378.—For makers of bicycle attachments for railroads.

Inquiry No. 6379.—For parties making instruments for dentists' use, such as nuts, threaded bars, jack screws, etc.

Inquiry No. 6380.—For makers of kerosene oil engines.

Inquiry No. 6381.—For makers of a specialty covered by patents, which can be worked up.

Inquiry No. 6382.—For makers of compressed air machinery for carpet cleaning.

Inquiry No. 6383.—For metal frames or clasps used in manufacturing pocket books, also for a simple, inexpensive apparatus for burning on leather wire brass or other type.

Inquiry No. 6384.—For parties to manufacture 5,000 or 10,000 thin brass plates, stamped, raised letters, as ordered.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(9515) J. H. B. asks: 1. How is it possible for a horse to receive a severe shock by stepping on the track rails of an ordinary electric road using overhead trolley? I know of a well-authenticated case of this kind. Has the nearness of a car anything to do with it? How could a circuit through the horse be completed? A. We cannot give a decisive judgment regarding the horse receiving a shock by stepping upon a rail of a trolley line. It may be said that many suppose the horse to be peculiarly sensitive to the electric current. Its iron shoes with nails reaching into the inner portion of the hoof are thought to facilitate the entrance of the current into its body. Again, there must have been a difference of potential between the rail and the adjacent ground sufficient to produce a current through the horse when he stepped upon the rail with one foot, and thus made a path of less resistance to ground for the current than was afforded by the earth in contact with the rail. If these several conditions were realized, a horse might receive a shock between the rail and the earth at its side. 2. What would be the effect of varying the resistance in the secondary of a transformer, the primary of which is fed by a constant current transformer. Please state effect on lamps on circuit B and explain action in full. A. We have not seen the arrangement you show in your sketch, a variable resistance in a transformer circuit, in multiple with lamps. We have not the means for testing the arrangement, but it seems to us that the variable resistance, if non-inductive, would short-circuit the lamps, and as the resistance was cut out, the lamps would give less light, since they would get less current.

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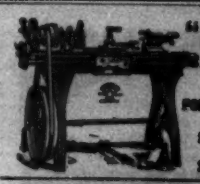
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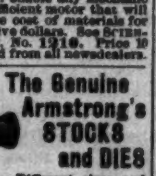
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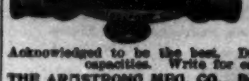
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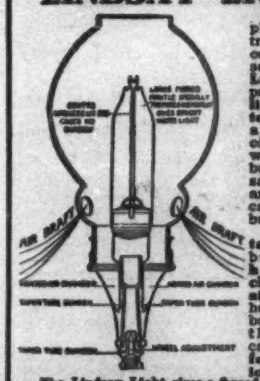

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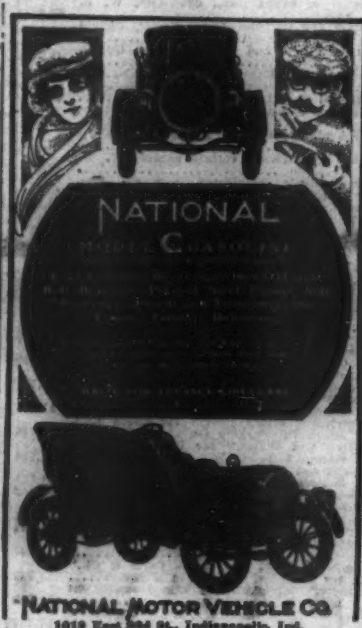

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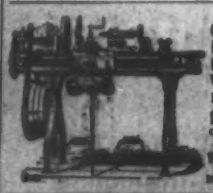

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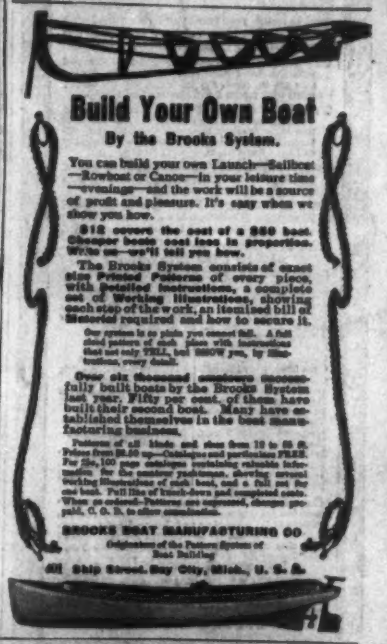

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